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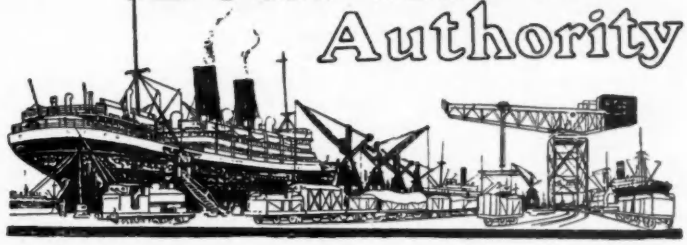

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Editorial Comments

Indian Ports and their Future.

In our issue for February last, reference was made to the appointment, early in 1946, of a Ports (Technical) Committee to examine and report upon the future development of Indian ports. A summary of the Committee's findings was printed in extenso, and it was stated that their recommendations had been forwarded to the maritime provincial governments, the maritime Indian states and the major port authorities concerned for consideration and comment.

The views of the interested parties were duly communicated to the Government of India, who, on 15th April last, passed a resolution showing that, in general, it has accepted the recommendations made. The Report of the Ports (Technical) Committee, which forms the leading article for this issue, provides an interesting and instructive example of a far-seeing and comprehensive approach to the problem of planning the economic development of a nation's port facilities, together with the expansion of existing, or the provision of new, ancillary services linking the country's sea-board with the interior.

The present complex political situation makes it evident that decisions on long-term policy requiring heavy expenditure will have to wait until the constitutional uncertainties are removed, especially as one of the Committee's basic principles is the economic indivisibility of British India and the Indian States. The contemplated division of India into Hindustan and Pakistan with the unknown destiny of the native self-governing States is therefore likely to seriously affect the programme of development for some-time to come.

As to the recommendations contained in the Report, the Government of India have agreed that Vizagapatam should be developed as a sheltered deep-sea port to accommodate ships at least up to 650-ft. in length and up to 30-ft. draft. There appears to be no necessity for an investigation into the need for another port between Vizagapatam and Calcutta, and as far as the Calcutta Ship Canal scheme is concerned, it is agreed that further expert opinion should be obtained.

The foregoing recommendations will meet with general approval, although in some quarters no doubt, there will be misgivings about the proposed development of Vizagapatam, on the ground that it is likely to divert trade from Madras and Calcutta, which would mean not so much the development of trade as its dispersal over a wider area. Whether or no trade would be encouraged so that there would be sufficient for all three ports to be used to their maximum capacity, can only be a matter for speculation.

With regard to the Calcutta Ship Canal, the construction of which has been the subject of controversy for many years past, the Government's decision to investigate the matter further, before finally deciding upon the feasibility of the scheme is judicious. The arguments put forward in favour of the plan are impressive and warrant the most careful consideration.

Owing to paper restrictions, the number of pages we are able to print is limited, and in view of the length of the Report, we have found it necessary to print each of the three terms of reference in a separate issue, and accordingly hope to refer to the subject again next month.

The Permanent Scheme of Dock Labour Decasualisation.

The long awaited Order under the Dock Workers (Regulation of Employment) Act, 1946, bringing into operation a permanent scheme for the decasualisation of dock workers at the principal ports in the United Kingdom has, at last, been issued by the Minister of Labour and National Service.

The new scheme is to be administered by a body to be known as the National Dock Labour Board, in which the Clyde and Mersey ports will now be included, and the National Dock Labour Corporation, which hitherto has administered the old scheme at all the ports in the United Kingdom, with the exception of those mentioned above, will be wound up.

At the Annual General Meeting of the N.D.L.C. held early last month, Lord Ammon, the Chairman, referred to the difficulties that have faced the Directors during the past financial year, and pointed out that the solution of their problems had been made more difficult by the lack of any clear idea as to the shape of the permanent scheme which is to take the Corporation's place. The salient points of his speech, and details of the new Order will be found elsewhere in this issue.

As Lord Ammon rightly said, the most anxious problem, which unfortunately, still remains to be solved, is the adjustment of the labour supply to the variable demands of the industry. The regulations of entry into and of exit from the industry seems to present great difficulty, and the responsibility for it will rest entirely with the new Board. Unless the dockers are prepared to accept the decisions of the Board however, there can be little hope of improvement, as has already been so regrettably demonstrated by the recent unofficial strikes at Glasgow and London.

Another important point is the question of payment for the cost of running the scheme by means of a levy to be determined by the National Board, and we agree with Lord Ammon that " it is clearly

Editorial Comments—continued

undesirable to increase percentage payments at a time when trade is bad, because that is increasing the burden on Industry at precisely the time it is least able to bear the charge " and his suggestion that the industry should aim at stability of the percentage levy, so that it prepares in good times against bad, is sensible and practical.

The new Board is fortunate in having the services of the experienced personnel of the old Corporation, and provided both employers and workers can pull together, there is greater chance of smooth working in the ranks of dock labour, than ever before.

Range Action in Table Bay Harbour.

The disturbing phenomenon known as " Range Action " which has manifested itself in the new Duncan Dock at Cape Town has been described in previous issues of this Journal (e.g., *vide* April, 1943) and on the last occasion of mention in the May, 1946, issue, it was stated that investigations by means of scale models were proceeding. It has now been announced in the Annual Report of the General Manager of the South African Railways and Harbours Administration for the year ended 31st March, 1946, just issued, that definite results have been achieved, and that the experiments made " have indicated that conditions in the Duncan Basin can probably be considerably improved by moving the entrance to near mid-length of the basin and by the construction of one or more piers inside the Dock." It is undoubtedly satisfactory to have the assurance that a remedy lies within the limits of possibility and, moreover, of economical practicability, for the suggestion which was made in the first instance by Mr. G. Stewart, who propounded the problem and its difficulties, that nothing short of an extensive outer breakwater would suffice, was so startlingly expensive as to be practically prohibitive. True, the alteration in the position of the entrance to the dock will involve considerable expenditure, but not nearly so much as a new breakwater.

However, the present announcement does not promise a complete cure, but merely a " considerable improvement," and the State Administration will have to determine whether the outlay on a change in the position of the entrance will be justified by the results to be obtained. Moreover, it would seem that to be really effective such a change must be undertaken jointly with the construction of one or more internal piers, and this may interfere with the arrangements on which the original design was based. The views of the Administration on these points have not yet been disclosed and, no doubt, there will be some consultations with shipping interests before a decision can be reached. The technical aspects of the matter are discussed in the extract from the General Manager's Report, which will be found on another page.

Three Centenary Celebrations.

During last month, there were held in widely separated towns of the British Isles, celebrations commemorating three centenaries —the first, of a well known North East Coast port, the second, of an important Engineering Institution, and the third, of the leading port of Northern Ireland. We will deal with them seriatim.

The Port of the Hartlepools.

Due to their close contiguity and to the identity of their commercial and shipping interests, it is inevitable that Hartlepool and West Hartlepool should be considered a port of single entity. The Centenary celebrations recorded in the present issue relate, however, exclusively to West Hartlepool. The Port of Hartlepool is of prior origin, as the Victoria Dock there, which adjoins the Old Harbour (and which, by the bye, has a separate jurisdiction, being administered by the Harbour Board of the Town, while the docks at West Hartlepool are owned and controlled by the London and North Eastern Railway Company) was opened as far back as 1840. The independent dock system at West Hartlepool was inaugurated by the Coal Dock, opened in 1847 in consequence of an Act of Parliament passed in 1844. A description of the joint ports was published in our issue of May 1938.

At a civic dinner in West Hartlepool, given as part of centenary celebrations, Sir Charles Newton, Chief General Manager of the London and North Eastern Railway Company, reviewing the history of the port, said that the harbour and docks at West Hartlepool owed their inception, on 1st June, 1847, to the vision and enterprise of Ralph Ward Jackson, one time Chairman of the Stockton and Hartlepool Railway—then a rival of the historic Stockton and Darlington Railway from which the present L.N.E.R. has descended. The connection between the Hartlepools and the L.N.E.R. began in 1857, when the railway took over the Hartlepool system of docks, those at West Hartlepool being acquired eight years later.

Sir Charles also announced that plans for two improvement schemes for the Hartlepools dock system are at present under consideration. Further details of these plans, and also some of his views regarding the Government's proposal to nationalise the ports, appear on another page.

It is to be hoped that the future destiny of the ports of this Country will soon be clarified, so that the improvements contemplated at the Hartlepools, and at many other ports around our coasts, can be carried into effect, as it is only by bringing our ports up-to-date that economies in cargo-handling and a quicker turnround of shipping can be effected.

The Institution of Mechanical Engineers.

The Centenary of this renowned Institution was commemorated from 8th to 13th June, and engineers from all parts of the world took part in the celebrations which were officially opened by the Lord President of the Council, Mr. Herbert Morrison. Meetings were held to discuss technical papers on a variety of subjects and visits were paid to engineering works in and around London. Among the more social events were a service in Westminster Abbey, a special reception by the President, Lord Dudley Gordon, at the Science Museum, South Kensington, and a banquet to the delegates at the Guildhall.

The Institution was founded in 1847 and had as its first President, George Stephenson, the pioneer of the locomotive, and the builder of the famous " Rocket." The names of many other famous engineers are to be found in the list of its past-presidents. Sir Joseph Whitworth, 1856 and 1866 is best remembered perhaps for his standardisation of screw threads. Lord Armstrong 1861 and 1869, the pioneer of hydraulic machinery for dock operation, was the founder of the Elswick engineering works of Sir W. G. Armstrong and Co., and Robert Napier, 1863 was one of the best-known marine engineers in the first half of the nineteenth century. John Ramsbottom , 1870-71, is notable for his many developments of the steam locomotive. Sir Alexander Kennedy, 1894-5, and Professor Cawthorne Unwin, 1915-16, were renowned as great teachers of mechanical engineering.

The headquarters building at Storey's Gate, Westminster, was completed in its present form in 1914. Since then, branches of the Institution have been set up in various parts of this country, in China, the Caribbean and the River Plate, and there are Advisory Committees connected with the Institution in Australia, Canada, Egypt, India, New Zealand and South Africa. Two months ago the Institution expanded its activities by an amalgamation with the Institution of Automobile Engineers and as a consequence has set up an Automobile Division.

The part played by the mechanical staffs of Port Authorities in port operation is one of great responsibility, and a tribute to their efficient service will be freely rendered by all port administrators and officials.

The Port of Belfast.

On 21st June, 1847, the Royal Assent was given to a Bill which had been promoted and became "The Belfast Harbour Act, 1847." It repealed all previous acts then in force, and constituted a new body, since known as the Belfast Harbour Commissioners.

Since that date, the Commissioners have always maintained a vigorous and progressive policy, and have been responsible for carrying into effect many schemes of improvement, which have enabled the port to attain the high position it can claim today, ranking as it does as the fifth port in the United Kingdom.

A short history of the port has just been issued by the Commissioners, and as the information is likely to be of general interest, we hope to refer to the subject again in our next issue.

The Port of Calcutta—River Hooghly frontage. Photo by courtesy of the Indian Railway Bureau

A Survey of Indian Ports

Technical Committee Advocates Extensive Development*

IN pursuance of a recommendation made at the meeting of the Policy Committee on Transport held on the 30th October, 1945, in New Delhi, and in agreement with the Governments of the maritime provinces, the Governor-General-in-Council constituted a technical committee with the following terms of reference:—

(1) Whether a sheltered deep-sea port on the East Coast of India for the accommodation of ships of large size and tonnage at all seasons of the year is required, whether construction is feasible and if so where; also what measures are necessary for establishing it;

(2) whether there is justification for the conversion of any minor ports on the Coast of India to major ports, if so, whether such conversion is practicable; also whether there are any other projects for construction of major ports which ought to be considered;

(3) what steps are necessary to develop minor ports in order to meet probable demands of coastal shipping traffic.

THE FIRST QUESTION REFERRED

The first term of reference to the Committee was evidently based on para. 15 (a) of the report of the Inter-Departmental Port Development Committee in 1945 which reads as under:—

" More deep-sea ports may be needed on the Coast of India to meet anticipated expansion of trade, and in particular one of easy access to large ships on the East Coast, but the figures of expected trade do not by themselves justify more ports."

Size and Tonnage of Ships to be Considered.

The Committee has first of all had to make up its mind what is the largest size and tonnage of ship that has to be considered, and has come to the conclusion that the deepest draft that need be provided for is 30-ft. and the greatest length 600-ft. These dimensions exclude from consideration the larger passenger ships of the P. & O., Orient and Union Castle Lines; in the view of the Committee such ships and even larger ones required for naval and military purposes, such as aircraft carriers or transports, cannot entirely be left out of account as will be seen later. But for ordinary everyday commercial purposes the ship of 30-ft. draft and 600-ft. length may be taken as the largest client of the eastern ports that ought to be catered for without serious restrictions.

*Summarised Abstract of the Report prepared by the Ports (Technical) Committee and submitted to the Government of India in May 1946. A Summary of the Committee's recommendations was printed in the February 1947 issue of this Journal.

MADRAS PORT

With the above standard of shipping before it the first port visited by the Committee was Madras. This harbour can accommodate large ships of the Strath and aircraft-carrier size, but cannot safely hold such ships in a cyclonic storm. Such storms are experienced from time to time in the period 15th October to 15th January and have to be taken account of. The shallow coastal shelf at Madras is narrow, ocean depths are comparatively close inshore and the seas that enter the harbour consist of deep translatory waves. During a cyclonic storm these set up a range in the harbour which on occasions breaks the ropes of ships and prevents them working at one or more quays, though not usually at moorings.

The Chairman of the Port Trust has in view a scheme for dealing with this range, and if this proves successful in breaking the oceanic swell entering the harbour, ships of 30-ft. draft and almost any length can use the port throughout the year, and the term or reference is fully met so far as its direct question is concerned.

Scheme of Improvement.

The Port Trust has under consideration a long term scheme for increasing its ship quay capacity by excavating a wet-dock to accommodate four large ships and later, as trade may require, ten ships. It would protect the entrance to this dock with some form of " spending beach " and a sheltering arm so as to reduce the swell.

The following extracts from a note written by the Chairman of the Port Trust fully explain the scheme:

" (a) The threat of sand drift closing the Harbour Entrance is no longer a formidable problem for the Board has taken steps to control the movement of sand by providing a dredging unit which will operate from the sand screen, and, it is hoped, will thus intercept the travel of drift well south of the entrance. Madras is a deep water sea port and can be kept as such; it has a large estate made up of the south accretion, the land ear-marked for the construction of the dock can be replaced by extending the harbour premises further south (up to the River Cooum if necessary) provided other authorities interested in the land to be taken over show a sympathetic interest in the development of the Port and its facilities.

There is no insuperable engineering difficulty to overcome in providing a wet dock at Madras capable of taking two or more 600-ft. vessels drawing 30-ft. but there is a preliminary problem

A Survey of Indian Ports—continued

to solve first before a dock can be constructed which will allow ships to lie alongside throughout cyclonic storms which affect the Port by setting up deep wave action or range inside the harbour.

(b) " Range " is the chief disability from which the port suffers. By " range " I do not mean waves which are raised by wind action inside the harbour and which may be three to four feet high, but do not extend deep enough to move a laden ship; I refer to those waves which are generated at sea and are propagated into the harbour during a storm; they only occur in a serious form when cyclonic storms are generated in the southern section of the Bay of Bengal and particularly when these storms travel north of the port; on these occasions, two or more berths become untenable depending upon the severity of the storm and the turn-round of shipping suffers in consequence. The reason why this problem has never been solved is because, during the years of peace, a delay of a few days to shipping although undesirable was not a matter of serious consequence and also because the reduction of range in a harbour to safe and convenient limits is not an exact science; it involves the construction of " spending beaches " or wave traps which destroy the energy of translatory waves and which have to be carefully sited after experiments on models are carried out. Some years ago range readings were recorded at this port and the highest observations which did not take into account " wind lop " were as follows:

Across the entrance	... ...	2-ft. 9-in.
At South Groyne	... ...	3-ft. 6-in.
At North Groyne	... ...	2-ft. 9-in.

Waves such as these are sufficient to render every berth in the harbour untenable for they extend to the bottom of the harbour. Usually at seaports exposed to wave action, the highest readings occur at the entrance and gradually become less owing (1) to the expansion or lengthening of the waves once they pass the entrance and (2) to the reaction of the still water inside the harbour. At Madras, however, it will be observed that the highest readings occur at the South Groyne, the harbour entrance being in the North Groyne. The reason for this is that the harbour is bounded by four vertical walls, which is consistent with the necessity for providing quay accommodation, but which helps to " build up " instead of decrease wave action. The south quay berths are, therefore, the first to go out of action (even before the East Quay which is nearer the entrance) and, if the storm is severe, the West Quays and North Quay follow owing to reflected wave action from the South Groyne.

(c) Range at this port could be reduced if short intercepting jetties were constructed along the inside of the eastern breakwater to form wave traps and if the entire South Groyne, instead of taking the form of a vertical wall, were given a slope of, say, 1 in 4, to form what is known as a " spending beach." An extremely interesting example of a small " spending beach " is the L.S.T. Hard near the west end of the South Quay; during the recent north-east monsoon, when a stream passing north but well eastward of the port rendered most berths untenable to shipping, two L.S.T.'s lay very comfortably at the Hard owing to the waves dissipating themselves up the Hard; the tip of the Hard was not sufficiently deep, nor was the Hard itself long enough to affect the ranging at the West Quay, but it did reduce the height of waves immediately east and west of the Hard.

(d) Apart from the proposal to construct a wet dock, I have been interested in the reduction of range for some years, but the war put a stop to experimental work I had in mind. Towards the latter half of November, 1945, however, when certain berths were untenable, the following experiment was carried out at the entrance to the Boat Basin, which is 79-ft. wide. A 2-in. pipe, punctured with ¼-in. holes at a pitch of 12-in., was laid across the bed of the entrance; both ends were blank flanged and through a 4-in. pipe connected to the centre of the 2-in. pipe, compressed air was pumped by a compressor. The air bubbles rose to the surface in the form of a curtain or screen and tended to destroy the energy of the waves in the line of the screen of bubbles; the air was switched off and on several times and each time it was turned on, there was a perceptible difference in the ranging on the Boat Basin side of the pipeline. The idea was not mine. It was tried out in America some thirty years ago with, it was claimed, some success, but to the best of my knowledge it has never been adopted in any of the Home or Empire Ports. There are difficulties to overcome such as keeping sand out of the line, barnacles from growing over and closing the holes, but further experiments will be carried out next November to try and arrive at a correct appreciation of its worth.

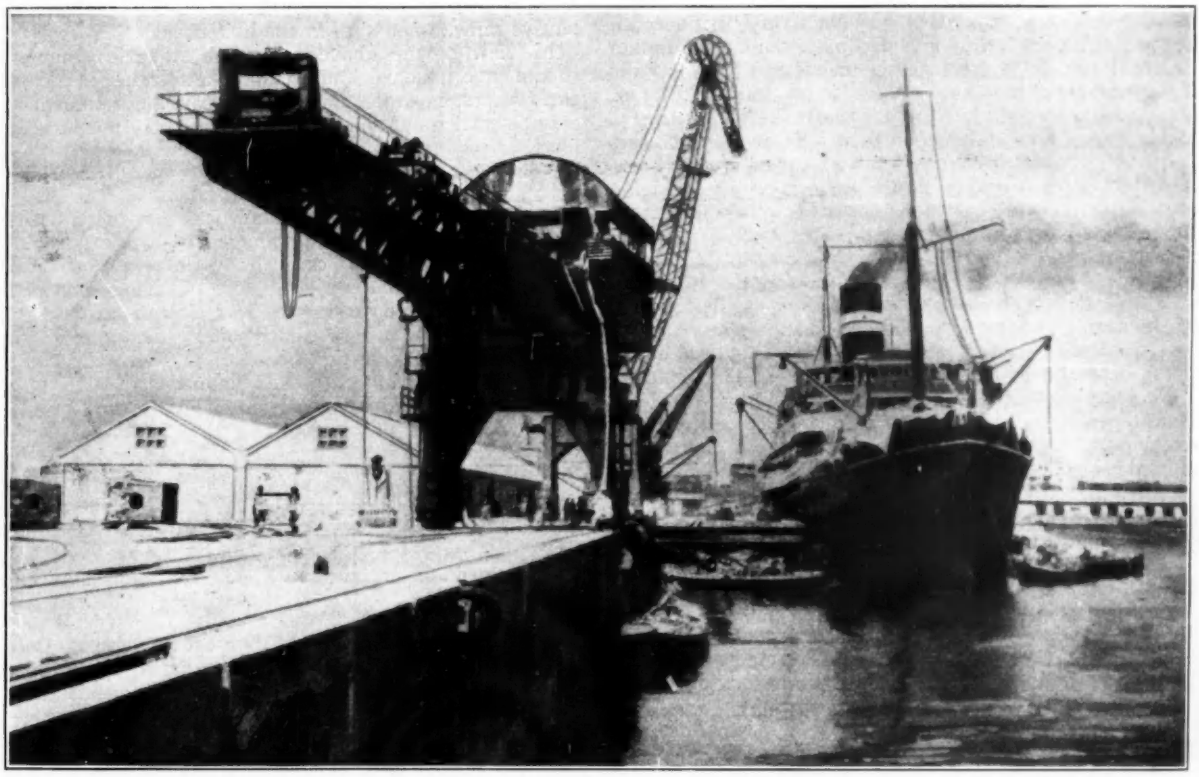
I believe that, if wave traps are introduced on either side of the entrance to the proposed dock, it will be possible to provide a 100-ft. entrance which could be fitted with gates, operable in all weathers.

If the experiments with what I call an " air breakwater " are

A Survey of Indian Ports—continued

successful and are combined with wave traps, range can be reduced to safe limits; in this case I would advocate increasing the entrance to 150-ft. in the interests of manœuvrability of ships in and out of the dock in order to avoid dock gates altogether which are very expensive to maintain.

I have laboured the subject of range intentionally for Sir Godfrey Armstrong has emphasised in his note that, if a dock is to be provided, it must be an all-weather one, and to meet this demand it is essential to solve the problem of range at this port.



View of South Quay—Port of Madras.

(e) The best way of providing additional accommodation on a large scale is obviously to construct a wet dock on the south side of the harbour and to provide that dock with up-to-date facilities such as ample quay cranes, modern double-storied transit sheds which will accelerate the rate cargo can be delivered and received, and adequate stacking areas served by land tugs and trailers.

(f) Entrance Works: The first requisite must be to reduce range at the entrance to the new dock. To do this a guide pier 20-ft. wide and 600-ft. long fitted with a wave trap is suggested on the east side of the entrance and a " spending beach " on the west side. The west side of the pier will be used for warping vessels into the dock after they have reversed in the outer harbour. The entrance has been given as 150-ft. in width which pre-supposes that some degree of success will be attained with the experiments to be carried out with an " air breakwater."

If the experiments are not successful, a sufficient reduction in range should be obtained by the wave traps on either side of the entrance to permit of dock gates being operated; in this case, the entrance will be reduced to 100-ft.

View of the Future.

Madras is advantageously placed geographically, as the port is at the capital of a province and has particularly good rail and road connections radiating in all landward directions. The present maximum capacity of the Port has been estimated at something like 1,750,000 tons of dry cargo per annum. By constructing a wet dock capable of accommodating 10 vessels and with transit sheds, the capacity of the Port could be increased to between five and six million dry tons a year.

The cost of such a dock is very great, being estimated at Rs. 5½ crores for the whole scheme. There are no indications that the trade is going to require full construction at an early stage. On the other hand, the margin now in hand for expansion of trade, based upon the difference between the estimated present port capacity and the highest previous annual tonnage of dry cargo handled, is only about 350,000 tons, and, if any considerable expansion of trade takes place in the south, a need for more ship quays at Madras may well be felt in the course of the next ten years. The extension scheme is divided into two stages and meantime we need consider only the first stage, which provides a dock with four additional quay-berths at an estimated cost of about Rs. 3¼ crores. Heavy construction work, such as is involved by this project, will probably take five years to complete, and, as it is advisable to carry out such work before the demand arises and the port capacity is strained, the Committee recommends that early consideration be given to Stage 1 of the scheme which would increase the capacity of the port to a figure of about 2¾ million tons of dry cargo per year.

VIZAGAPATAM

Here the particular physical features that limits the size of ships is the entrance channel which cannot be relied on always to take ships exceeding 28-ft. in depth and cannot always safely pass a ship exceeding 570-ft. in length. The Committee, therefore, put to the General Manager of the Bengal Nagpur Railway, which now operates the port, the question whether the entrance could be improved to take ships of 30-ft. draft and 650-ft. in length at all times and received the reply that this could be achieved at a cost of Rs. 13 lakhs and further that, if the future could be content with ships of 30-ft. draft and 600-ft. length, it could secure this at a probable cost of only six lakhs of rupees. This latter figure is a very small expenditure when it considered that it enables the port to take at all seasons of the year ships of the largest size that

A Survey of Indian Ports—continued

the Committee thinks will normally visit there. At the same time it does not provide for the larger type of aircraft carrier or transport that naval or military requirements might sometimes demand. Moreover, it was also pointed out that it was safer from the practical point of view to carry out the scheme in full at one and the same time and incur the whole expenditure. We would, therefore, strongly recommend that the expenditure of Rs. 13,00,000 be faced and the entrance be made suitable for ships of 30-ft. draft and 650-ft. in length.

Past History and General Design.

It is desirable, before going further, to give a very brief account of the history of this port and its intended place among the Indian harbours. Inside the short entrance channel formed between the high bluff on the Dolphin's Nose on the south and the City of Vizagapatam with its small hills on the north lies an extensive basin, eminently fitted for a large harbour. Some twenty years ago, the port was converted from a small and comparatively unimportant calling place for ships into a major port by dredging and reclamation works and construction of a few quays and other port works and was left to attract trade to make itself a successful commercial enterprise. Later the Raipur-Vizianagarm Line was opened to connect the new venture with the Central Provinces which is the area to be served by it. But during the last twelve years since its completion, trade to the extent anticipated has not materialised, dredging has been a heavier expense than was hoped would be the case and in fact the port has not been a financial success. We were told that the railway rate policy has also been been responsible for preventing the cargo from the hinterland moving to the port. Although we have not been able to examine the extent of the justification of this allegation, we have no doubt that a well-thought-out railway rate policy would have drawn a larger volume of traffic to this port and would have thus strengthened its ability to balance its budgets in the past.

The war has not helped very much since, though additional facilities have been provided, the steady trade development has been interrupted and military traffic has not been sufficiently heavy to form an adequate substitute for it. This year the Government have decided to hand over the port for operation and administration by the Bengal Nagpur Railway and it has become to all intents a purposes a Railway Port.

The Theory of the Paying Port.

It is difficult to say when a port is a paying proposition. So far as the major ports in British India are concerned, they balance their budgets by raising the dues on vessels and charges on goods. We have no data to guide us as to the relevant burdens which ports in British India and Indian States impose on shipping and on trade. Without taking these relevant facts into consideration it would be difficult to examine and enunciate the theory of a paying port. It has been contended that the ports in Indian States have been able to put comparatively light burdens on shipping and trade, because these ports are financed from the general revenues of the State. The policy of arriving at a balanced budget by taking the receipts from the ports and railways together as against the aggregate expenditure on the ports and railways has been called into question. It should not, however, be forgotten that large ports in British India have only been able to balance their budgets after bringing into the common pool their large incomes from such sources as land, buildings and railways. Without the inclusion of incomes from such sources in the general revenues of the port some of the ports would show a considerable deficit.

At first sight it would appear unsound in principle to construct a new port which, while it cannot be itself a paying proposition, might have the effect of diverting trade from other ports thus forcing those ports to raise their dues to make up for reduction in tonnage. But there are cases in which a port of this description can be recommended: firstly, when a long-term policy demands the opening of a new harbour which is required for development of an area and cannot possibly pay till that area is developed, and secondly, for strategic reasons in the interests of the country's defence and world position.

Reasons for Developing Vizapagatam.

The Committee is of the opinion that, on the grounds of defence and strategic requirements of the country and the industrial, agricultural and economic development which is sure to take place in the near future, and also in view of the need for wider dispersal of port capacity throughout the country, a deep sea port where ships could safely enter at all times of the year and in all weathers is a great necessity. It is also desirable that the port should be centrally situated on the East Coast and the Committee feels that Vizagapatam would be a suitable port for such development, the more so because the Railway Board have already planned an extensive railway net work in the hinterland.

In view of the above paragraph, the Government of India should give financial and technical assistance, particularly in the early stages, in order that the necessary development in the Port may be carried out and the port charges may not be kept at a high level.

Scheme of Improvement.

In the war period the limitation was, not the entrance channel, but the lack of quays and water space in the harbour, as there were only three regular cargo quays in operation. Vizagapatam is, however, potentially a large port and there is no physical difficulty to be met in enlarging the port so as to take 20 ships or more when traffic demands them. While geographically the port is well placed, the country behind it is poorly developed. Much money has already been spent, and if an adequate return is ever to be obtained more must follow. That is an argument for increasing facilities in advance of trade, and taking this view the General Manager recommends works being undertaken in the following order:

One new quay	2½	lakhs short term work
Oil and coal quays	16	lakhs long term scheme
Graving dock	60	lakhs long term scheme
Improvement of entrance ...	13	lakhs long term scheme

The Graving Dock.

Another proposed facility of the port is a graving dock which is expected to cost about Rs. 60 lakhs. This is a proposal of importance and the Committee gave it careful consideration and their conclusion is in favour of it.

The Scindia Co. have laid down a very fine ship-building yard which is the only one of its class in India and, as it is the country's policy to build up a substantial mercantile marine, every encouragement should be given to this industry. The possibilities of a naval base cannot be disregarded nor the strategical value of the harbour. The General Manager of the Bengal Nagpur Railway, with whom the Committee had a discussion on the subject, favours the building of this dock by Government as a normal port facility and also as an encouragement to the general trade of the port. Admittedly a graving dock is not in itself a remunerative facility, but at Vizagapatam, the dock may prove of the greatest help to the Navy, to the shipbuilding yard, and to the port in general. It may be contended that there is little to be said for sinking more capital in a port already unable to pay interest on its present capital expenditure, but the point is that, unless the harbour develops into a really first-class port, Government can never get any return on its capital, whereas the existence of a modern graving dock must at least tend to encourage ships to visit Vizigapatam and so help to bring fruition to the original hopes on which the whole harbour scheme was started.

CALCUTTA

Calcutta is by far the largest port in India so far as the tonnage handled is concerned. That is because of its enormous traffic in coal, jute, pig iron and tea. In value of trade, the comparisons are entirely different, but a port is principally concerned with the weight and bulk of the commodities it has to handle and the Committee calculates the work of Calcutta Port on this basis.

Yet, Calcutta, owing to the difficulties of the Hooghly channels, can frequently only accept ships of 26-ft. draft and can only on rare occasions receive ships of 30-ft. draft. This must be

A Survey of Indian Ports—continued

regarded as a serious handicap in a port of such importance and proved to be the most serious limiting factor during the war. The possibility of removing or at least very materially reducing it is now receiving the earnest attention of the Port Commissioners. A scheme is under consideration for building a ship canal from the docks to Diamond Harbour 42 miles down the river. The canal projected is to be 25 miles long and to cut out 42 miles of river, thus making a saving in distance of 17 miles to ships and incidentally the avoidance of the most dangerous section of the Hooghly River passage.

Proposed Ship Canal.

The case for the canal is given in the following terms by the Chairman of the Port Commissioners:

"1. A ship canal will give the following positive and immediate advantages:

Kiddapore Dry Dock, Calcutta.

(a) The most difficult part of the navigation of the Hooghly is between Diamond Harbour and Calcutta and this part will be avoided. Navigation between Sandheads and Diamond Harbour is comparatively easy and the pilotage can be entrusted to a smaller and less highly specialised service than the Bengal Pilot Service. Ships will need to be piloted through the canal, but the work will be simple compared with pilotage on the Hooghly. A reduction will also be possible in the number of Assistant Harbour Masters. No ship loading and discharging in the docks will go out into the river at Calcutta, but some Assistant Harbour Masters must be retained to transport ships from the existing dock locks to the Calcutta or Garden Reach Jetties or mooring in the stream.

(b) There will be a great reduction on the amount of dredging to be done. The Commissioners now maintain three large suction dredgers for the maintenance of the navigable channels and these dredgers are practically solely employed on bars between Garden Reach and Diamond Harbour. Very occasionally a dredger has been tried in the Lower Reaches for short periods, but the total amount of time thus spent is negligible and there is no doubt that three suction dredgers are needed to maintain the Upper Reaches at the present standard. This ship canal will probably obviate the need for any dredging in the river between Diamond Harbour and Garden Reach. With the cessation of dredging there is no reason to expect that conditions will not return to those prevailing before 1906 when dredging was begun. The depths on the bars then fluctuated greatly, but there was no changes in the general regime of the river. It may possibly be considered inadvisable to leave the port without a single suction dredger because, if there is no dredging, it is conceivable that siltation at certain places may continue to such an extent as to affect the regime. The chances of this happening are, however, so remote that I think it can correctly be said that the Commissioners will be saved three suction dredges.

(2) Apart from the above positive and immediate advantages of a ship canal there are the following possible future advantages:

(a) The problem of increasing the available depths to vessels will be a much more limited one than it is now. The ship canal will, of course, mean that no bar above Diamond Harbour can affect the drafts of ships, but since dredging was undertaken on its present scale, conditions below Diamond Harbour have during the major part of every year controlled drafts. The Balari Bar is now the worst bar below Diamond Harbour and this bar might possibly be improved by dredging, but at other times other bars which could not be dredged have been the controlling factor. A permanent increase of permissible drafts cannot therefore be obtained by dredging and the only way of obtaining one is by river training works. Under present conditions, river training works would be required from Calcutta to Sandheads, but with the ship canal they will only be required below Diamond Harbour. Such wide changes take place in the position of the channel at the mouth of the river that it is difficult to imagine any training works which would give a permanent improvement, but this is a matter on which expert opinion will have to be taken. It is quite possible that experts will regard as more feasible the construction of training works to maintain the Rangafula Channel above Saugor Island, and to improve Channel Creek and the Baratola River which is narrow and in its lower reaches give a permanently deep passage to the sea. The desirability of developing this passage was advocated by Mr. Oag, Deputy River Surveyor, in a report which he recently wrote.

(b) The construction of the ship canal will enable the Port to be economically expanded to any extent which may become necessary. It will be a simple matter and comparatively cheap to provide docks off the canal and to obtain all the advantages of concentrated development. It is true that even now we can, by developing King George's Dock to its maximum extent, and reconstructing the Calcutta Jetties, provide for the handling of more than double the maximum traffic we have ever been required to handle in the past, but the next step beyond that would be the removal of coal shipping from Kidderpore Docks to riverside berths at, say, Ulubaria. This step would enable more general produce berths to be constructed in Kidderpore Dock if the single lock entrance was considered adequate to bear the extra strain, but this would be the limit to economic expansion. It may now seem inconceivable that the Port will ever be required to handle more than double the maximum pre-war traffic, but seven years ago the idea of a total seaborne traffic of over ten million tons would probably have appeared fantastic. In this connection I may mention that the possibility of a big increase in traffic is an additional argument in the favour of the ship canal because there is a limit to the number of ships which can move at one time in the Upper Reaches.

The cost of the canal is estimated roughly at Rs. 15 crores. Assuming that the money can be borrowed at 3 per cent. and the loans are to be redeemed in 60 years the annual expenditure in interest and sinking fund charges would be Rs. 54 lakhs. It is estimated that the net savings in revenue expenditure on account of the ship canal plus the interest and sinking fund charges on some capital expenditure which will be avoided may amount to between Rs. 22 and Rs. 25 lakhs a year; taking the latter figure the nett increase in the annual revenue expenditure of Calcutta Port will be Rs. 31 lakhs."

Other Improvements.

Apart from the ship canal, Calcutta has large schemes of dock development which cover an increase in the size of King George's Dock, new mechanical coal shipping plant, and better laid out railway yards. The construction of the canal will, however, alter the proposed dock lay-out, and a decision on the canal is desirable before the Commissioners' dock improvement schemes are implemented.

Conclusion.

As regards the proposals for a ship canal scheme and River Training work, the Committee feels that it cannot, on the data available before it, say that those proposals are financially sound or will effectively attain the object which they have in view. The Committee would, however, welcome the fullest and the earliest investigations of the improvements to the navigable approaches to

A Survey of Indian Ports—continued

the Port of Calcutta and the drawing up of a scheme for that purpose which would, without permanently affecting deep-sea navigation in the Upper and Lower reaches of the Hooghly, provide facilities for steamers with deeper drafts to navigate to and from Calcutta at all times. The Committee, therefore, suggests that the technical, financial and other relevant aspects of this or any other scheme, with particular reference to its permanent repercussions on the Upper and Lower Reaches of the Hooghly, should be fully examined by experts. And in connection with the proposed extensions of King George's Dock the effect of the policy of dispersal of industries on the volume of traffic that will flow through the port in future should be fully gone into.

CONCLUSION OF FIRST TERM OF REFERENCE

(a) Looking back at the above paragraphs readers of this report must inevitably feel that the Committee has not taken quite such a coldly economic view of the eastern port position as might have been expected of business and professional men planning a profitable course of business advancement for Government. But what the Committee has recommended are long-term works. They cannot be expected to start full repayment of money spent from the day they are finished and brought into use. This is not expected of a long-term work. The question is not whether these projects will immediately start paying for themselves, but whether they are considered necessary and desirable in the ultimate interests of the country as a whole.

(b) Any large expansion of trade and industry in South India will strain the Port of Madras unless the port and city are prepared to surrender their position and new trade to the Port of Cochin, even that pertaining to the Madras hinterland. Vizagapatam can never succeed till it is developed into a first-class modern harbour, and the community cannot afford to write off its hopes of it becoming one. Again, Calcutta as the largest port in a country committed to economic expansion and providing the natural outlet for so many commodities suffers from physical disadvantages to an extent probably not experienced by any other port of its size and importance in the world. Improvements of the natural approaches are, therefore, called for and without them Calcutta will continue to bewail the Hooghly River with its tidal bores and sand banks and its restriction on the size of ships.

(c) There may be a stage in every large undertaking when financial considerations are not the only or even the main ones. The value of a port is not solely to be reckoned in terms of economic integrity, and the financial side, though of the highest importance, is not always paramount. Judgment of a port is not made on the basis of a few months or even a few years work. It is based, rather, on the service a port renders through decades and centuries, and we must look far ahead in determining the best course of expansion.

(To be continued)

Dock Workers (Regulation of Employment) Order, 1947

Permanent Decasualisation Scheme

The Minister of Labour and National Service has made an Order under the Dock Workers (Regulation of Employment) Act, 1946, which brings into operation a permanent Scheme for the decasualisation of dock workers in the principal ports. The Scheme will operate as from 30th June, 1947, in the Merseyside and Clydeside ports, and from 28th June in other ports, and will replace the temporary war-time schemes for the decasualisation of dock workers set up by the Minister of Labour and National Service under the Essential Work (Dock Labour) Orders, 1941-1945, and by the Minister of Transport.

The Act provided that the two sides of the dock industry might formulate a permanent Scheme; but the employers' and workers' representatives were unable to reach agreement on certain fundamental issues, and asked the Minister of Labour and National Service to prepare a Scheme under the powers vested in him by the Act. Before doing so, he appointed Sir John Forster, K.C., to hold an Inquiry, and, after the receipt of Sir John Forster's report, the Minister prepared a draft Scheme.

Following the publication of the draft Scheme on 4th March, 1947, a number of objections were lodged against it. Accordingly, on 29th April, 1947, the Minister appointed Mr. John Cameron, D.S.C., K.C., to hold an Inquiry into the various objections raised and to make recommendations. Mr. John Cameron submitted his report to the Minister on 31st May, 1947. The Minister has followed Mr. Cameron's recommendations in the Scheme, which has now been made.

The main provisions of the Scheme are as follows:—

Scope and Administration

The ports and, with a few minor additions and exclusions, the classes and descriptions of dock worker to whom the Scheme is to apply are those covered by the existing schemes.

The Scheme is to be administered by a new body to be known as the National Dock Labour Board, consisting of a Chairman, Vice-Chairman and not more than ten members, all appointed by the Minister. Eight members are to be appointed on the nomination of the National Joint Council for the Port Transport Industry, four to represent dock employers and four to represent dock workers. Appointments to the Board will be announced shortly.

The National Dock Labour Board will be responsible for a general and financial policy and administration and will determine the numbers of workers to be included in the dock registers. The National Board has power to delegate the local administration of the Scheme to Local Dock Labour Boards, to be set up in each port or group of ports covered by the Scheme. Each Local Board will be appointed by the National Board and will consist of an equal number of representatives by Employers and Workpeople.

Guaranteed Payment

The Scheme provides for guaranteed payments to registered workers, to be made under the terms of either:

(a) An agreement for that purpose come to by the National Joint Council for the Port Transport Industry, or,

(b) Failing such agreement, a determination reached in such a manner as the Minister may approve.

On 31st March last, the National Joint Council advised the Minister that they had failed to reach agreement on the question and accordingly, on 3rd May, 1947, the Minister appointed a Committee of Inquiry, under the chairmanship of Sir Hector Hetherington, to consider the amount and basis of calculation of the guaranteed wage, and to make recommendations. This Committee reported to the Minister on 2nd June, 1947, and recommended as follows:—

(a) That there are meantime grounds for retaining an Attendance Payment in cases where a man is required to attend for work but is not engaged; the amount of the payment should be 5s. 0d. for attendance at each of the eleven normal turns in the week when work is not secured.

(b) That the total guaranteed weekly payment be fixed at £4 7s. 6d. per week.

(c) That against this guarantee should be set all payments of Attendance Money and all earnings, except those accruing in respect of work on Saturday afternoon.

Thus, where in any case the total of Attendance Money and all earnings other than those accruing from work on Saturday afternoon is less than £4 7s. 6d. in any pay week, a further payment should be made to bring the weekly wage up to this amount; where those payments equal or exceed £4 7s. 6d., no further payment will be due.

As it will be administratively impossible for a new guarantee to operate as from the dates of operation of the new scheme, the Scheme provides for the continuance of the existing guarantees

Dock Workers (Regulation of Employment) Order, 1947—continued

until not later than 1st November, 1947. Should no agreement on this matter be come to by the National Joint Council, the Minister will arrange for a determination to be reached. He proposes that this determination should be on the basis of the recommendations of the Hetherington Committee.

Registers or Records of Dock Workers

The Scheme provides for the delegation to the Local Boards of the responsibility for keeping, adjusting, and maintaining the registers or records, and a Local Board may appoint a committee for this purpose. The existing Port Registration Schemes will disappear in the ports to which the new Scheme applies. Those employers and workers who are on the registers immediately before the dates of operation of the new scheme may, if the Board so decide, be taken on to the new registers.

Subject to the general responsibility of the National Board for the administration of the Scheme, the Local Board will be responsible for securing compliance with the provisions of the Scheme, subject, however, to full rights of appeal. The Appeal Tribunals will consist of persons nominated by the Local Joint Committees, but not themselves members of the Local Board.

Finance

The cost of the Scheme is to be met by contributions from employers based ordinarily on a percentage of the wages paid to workers. The levy will be determined by the National Board. Before imposing a levy exceeding 25 per cent. of gross wages, however, the National Board must report the matter to the Minister.

The National Dock Labour Corporation Limited

Chairman's Speech at the Seventh Annual General Meeting

Presiding at the annual meeting of the National Dock Labour Corporation, Ltd., held in London early last month, the Rt. Hon. Lord Ammon, P.C., D.L., J.P. (Chairman), after reviewing the Accounts in detail, said that although their financial position was now satisfactory, their checkered experience had shown how essential it was to maintain an adequate balance to provide a cushion against the effects of the ebb and flow of trade. No other Industry except Shipping, so closely reflects the general industrial fortune of the country. No other Industry is so sensitive to the variations of international trade. Our national prosperity is particularly dependent on overseas markets and therefore dependent on factors over which we have so little control; that has been our strength and our weakness. But each variation abroad—a bad harvest, famine, revolution, or even storms at sea—affects the livelihood of our men on the docks.

The vicissitudes of employment in the docks during the year under review arose from all these causes and particularly from the grim struggle of this country, striving to repair its industrial position in a world in which the normal channels of trade have been broken by war.

One example of the sensitivity of docks to the current industrial situation was seen in the aftermath of the fuel crisis as it affected the docks. At the time, large sections of industry were reduced to a standstill and exports naturally diminished afterwards. Labour, in consequence, stood idle at the docks.

Another example was the import of timber. For months, men stood idle while difficult negotiations were pursued abroad to secure much-needed timber for housing and industrial programmes. When, eventually, negotiations were completed and timber arrived late in the season, shipping was bunched and they were seriously short of labour in the timber ports.

The Labour Supply Problem

The core of their problem was, the adjustment of labour supply to the variable demands of the industry. There is a nice phrase in the Essential Work (Dock Labour) Orders namely, that they must maintain "sufficient but not more than sufficient" workers to man the ports. This statement no one has been able to define either in terms of numbers or as a formula. Their experience this year provided a good illustration of the difficulties in trying to give effect to this phrase. During the early part of the year they were carrying some 8,000 men surplus a day. Representations were made to the Minister that it was imperative that the numbers of men they were employing should be adjusted to the foreseeable needs of the ports. The National Joint Council and the Ministry of Transport joined with the Corporation in a Fact Finding Committee which consulted with the ports as to the numbers of men required. But even with all the local knowledge and the information provided by the Ministries it was found that the numbers suggested by the Committee could, at best, be little more than an approximation to the needs of the ports.

It is not enough, Lord Ammon continued, to try and get the proper number of men. They must be the right kind of men, with the right proportion of specialists and the right percentages of different age groups. In other words, the entrance to and exit from the industry must be controlled—so that the labour force can be adjusted to the work of the port. He was glad to see that responsibility for the work of Registration is placed squarely on the shoulders of the new Board. That is a step in the right direction and should help in building up a competent and efficient labour force in the industry.

There has been some progress in this matter in that certain principles have gained acceptance on both sides of the industry throughout the ports. The first of these is that there must be some stability of employment in the industry. Although there will be necessary adjustments of the Register from time to time, decasualisation does imply that men will be employed for continuing periods.

The second principle is that there must be a marginal surplus of labour which the administrators of any scheme must carry. They were not in a position to assess this figure but probably it could never be less than 10% of the total labour force.

The third principle is that, although the job of the industry is to turn round the ships in the shortest time, it cannot be expected that enough men can be carried on the pay-roll to meet every possible peak. It cannot be stressed too heavily, how vitally urgent it is to see that our ships are at sea and not lying idle in the ports; that is absolutely essential if the flow of raw materials we so urgently need for our workshops is to be maintained, if sufficient exports are to reach overseas markets, and indeed if the national production programme is to be realised.

But there may be occasions when, for unforeseen reasons, traffic may so peak in a port that there will be a temporary congestion. Then it may not be possible to man all ships fully with the registered labour force available.

This principle is accepted centrally by the employers and is becoming increasingly accepted in the ports.

Lord Ammon then suggested another consideration. Last year, the Corporation had spent some £400,000 more in Attendance Money than in 1945. They were able to meet that charge only by calling heavily on their reserves and by making two increases in percentage payments; but it is clearly undesirable to increase percentage payments at a time when trade is bad, because that is increasing the burden on industry at precisely the time it is least able to bear the charge. His suggestion was that, as far as possible, they could aim at stability of the percentage levy—or whatever other means may be used to raise the income for the Scheme; in short, that they should prepare in good times against bad. Frequent variations in charges are unsettling to the port users.

Labour Disturbances

Referring to labour difficulties, the Chairman said that, by and large, the disturbances in this industry have not been as bad as some statements in the Press would lead one to believe. But even so, during last year, time lost on strikes represented one-half of one per cent of employment on the docks, and this meant a loss of more than 40,000 man days, a matter that cannot be dismissed lightly.

National Dock Labour Corporation—continued

The disturbing feature of these strikes is the unofficial and often quite irresponsible leadership of men without authority. They flourish for a day and having wreaked their trouble, disappear into the anonymity of the mass, leaving the Trade Union officials the thankless job of clearing up the difficulties created. He had great faith in constitutional minority movements, if the leaders accept the responsibility of their leadership; but leadership without responsibility is plain sabotage. That is one of the dangers of our time.

Policy and Practice

In looking back over the experience of the Corporation, Lord Ammon thought he could see a policy emerging. But practice necessarily came first and policy grew out of practice. The Corporation was set up to do a number of practical jobs—to hold together under the difficult conditions of war a body of men so as to secure a quick turn-round of ships, to pay Attendance Money, to pay Holiday Pay and to collate and pay wages and other mundane jobs. Decasualisation was incidental to these first war duties. There were, of course, obligations for employers and men, and penalties for those who infringed the conditions of the Schemes. At the beginning, both employers and men were concerned to see that the scheme was operated as a temporary war-time measure only, with the minimum encroachment on port practices and individual industrial rights.

This attitude has changed very considerably of late, and there has been a much closer relationship with the National Joint Council and with the Local Joint Councils.

But the major changes of outlook among those in the industry have resulted not so much from conversion as from practice. They had established new " manners "—the manner of engagement in Call Stands instead of at the ship's side; the manner of having one's pay weekly, instead of daily; the manner of allocation to work by the Port Labour Officer. These and other " manners " have produced the changed habits of thought. So that, to-day, no one would argue that the docks should be manned with casual labour, though that was the common practice but a few years ago. Times as well as manners have changed, and economic stability has produced new convictions.

One example of this change of outlook—and a very important change it is—had been the co-operation they had received in the preparation of plans for adequate Port Welfare Services. Also in other welfare activities there had been increasing co-operation between the Corporation's officers and the men who are taking a large share of the responsibility of running their own schemes and raising considerable monies to do so.

Regulation of Employment

Of the various aspects of policy which he saw emerging from practice, the most important is that of the regulation of employment—a phrase most appropriately embodied in the title of the new Act. It marks the next stage in their social programme on the docks. At the beginning of 1940 decasualisation was still in the realm of theory. During the past six years that theory has been translated into fact. The idea of regulating employment is not new; every registration scheme, every preference system and many port practices were evolved in the inter-war years to secure regularity of employment for particular groups of men. Before this problem can be solved, a good number of these practices and preference systems will have to be examined. Some of the preferences and practices are very deep-rooted and the men (and very often the employers) would not give up such preferences under a Corporation Scheme which was only temporary. But, under the new permanent scheme, surely the contradiction between the preference systems based on casual labour and the new set-up will be so apparent that these anachronisms will be removed, and only the best of the traditions and practices will be carried forward into the future.

The Future

The Corporation's Directors had been considering the position of the Corporation in relation to the new Dock Labour Board, with a view to easing the problem of the new administrators. The transition from the temporary to the permanent Schemes must be effected without break and without friction. It will need the effort of every man of good will to ensure that the new venture is launched, as it deservedly should be, with high hopes and satisfaction among the men, the employers and the administrators.

Obviously, the first requirement was to make sure that there would be an adequate and efficient administration available for the new Board. The existing Corporation staff had been invited to continue without break in the service of the new Board. This they had agreed to do, and Lord Ammon was confident that they will make every effort to assure the success of the working of the new Scheme both during the transition and after its introduction.

Table Bay Harbour

Investigation into Range Action*

Investigations in connection with range action in Table Bay Harbour were continued throughout the year, and experiments with the large-scale engineering model of the bay and docks have indicated the most likely directions in which the problem may be solved. The correct simulation in the model of the conditions in nature is dependent upon the simultaneous operations of two separate wave paddles, one in the north and the other in the west channel of the bay, and the problem of adjustment of these paddles has been solved. The question of wave form was largely settled by recourse to theoretical hydrodynamics, which indicated the nature of water particle movements within a wave of the types required, and paddle movements were accordingly adjusted to give the appropriate water particle movements. Slight modifications to these settings were necessary to ensure the condition for dynamical similarity in order that the waves in the model expand in a manner similar to wave expansion in the actual bay.

The amounts of wave energy entering the bay through each approach channel was determined, while a special series of experiments were undertaken on the model in order to establish how wave energy was dissipated during the propagation of waves over shelving ground. This was solved and checked approximately by a graphical method, and the amounts of wave energy entering the bay at the paddle positions thus gecame known for any assumed direction of approach of the waves from the outer ocean. Special dynamometers which would automatically measure the power transmitted by the paddle-driving machines were designed, and these instruments provided data from which the machine settings were eventually evolved. The correlation of range in Table Bay Harbour with weather disturbances far out at sea was further followed up.

The behaviour of vessels when range action obtains is being studied. It would appear that the size and draught of a ship, its position in the dock, the manner of mooring and the number and condition of the ropes used for tying up the vessel are decisive factors in determining the behaviour of the ship under range action. A heavy-laden vessel may lie comparatively quiet, but the same ship without cargo may move dangerously, or vice versa. It is necessary, therefore, to consider the problem theoretically as well as from actual observation, and tentative conclusions have been reached which are being further examined. Experiments have indicated that conditions in the Duncan Basin can probably be considerably improved by moving the entrance to near mid-length of the basin and by the construction of one or more piers inside the dock. Other and more elaborate solutions are known to exist.

It is already apparent from the model experiments that the direction of approach of the waves from the outer ocean is of relatively minor importance and affects for the most part only the magnitude of the resultant oscillations in the harbour and not their critical periodicities.

*Excerpt from the Annual Report of South African Railways and Harbours.

PORT OPERATION

Part 3 (C) of a series of articles by A. H. J. BOWN, M.Inst.T., A.C.I.S. and Lt.-Col. C. A. DOVE, M.B.E., M.Inst.T.

(Continued from page 48).

Design and Layout (continued)

Dock Railway Sidings

The sites of exchange and other dock railway sidings are determined largely by the size and shape of available land. In consequence, they vary considerably from port to port as is illustrated by the following three examples which have been selected because they are fairly typical:—(1) In Royal Victoria Dock, London, the very extensive sidings on the north side of the dock, which are amongst the largest in the world, are situated inside the dock boundary wall next to, and roughly parallel with the line of warehouses, which are in turn parallel with the through road and the berths. (2) In Alexandria, one of the oldest ports in the world, the main sidings are situated outside the dock walls roughly at right angles to the general line of berths (except for two central jetties and three jetties at the western end) and at approximately the centre of the harbour. (3) In Kidderpore Docks, Calcutta, the main exchange and other sidings are situated at one end of the dock and laid roughly in a straight line with the docks, so that the lines lead directly on to the quays. All other things being equal, this is probably the best design, for it enables the dock railway staff to comply with the very important railway yard working principle that wagons should "move in one direction only" (Mr. R. H. Nicholls, C.B.E., International Railway Congress, London, June, 1925) on the way to their destinations.

Wherever they are situated, however, the functions of the railway sidings are the same, namely, to provide areas on which (1) railway wagons may be exchanged between the port organisation and the railway organisation or organisations; (2) inward-bound railway wagons may be sorted to berth, transit shed or warehouse order and accordingly made up into rakes for placing at their destinations within the dock; (3) outward-bound railway wagons, i.e., wagons leaving the dock area, may be sorted into train order, and where possible into marshalling yard or station order, ready for handing over to the railway organisation.

Photo by courtesy of Mersey Docks and Harbour Board

The Port of Liverpool showing the Gladstone Dock and Branch Docks. Graving Dock (left), power house right of entrance to dry dock, caisson entrance (in position), roof cranes to transit sheds (note greater length of crane jibs plumbing the quays and shorter lengths of crane jibs at rear of sheds). Ordinary portal quay cranes on extreme right.

Exchange Sidings

The sidings on which incoming and outgoing trains are exchanged between the port undertaking and the railway company or companies, are known as Exchange Sidings. (In railway owned docks these sidings are usually known as "Reception" or "Arrival" sidings, and sometimes separate "Departure" sidings are provided).

The length of the exchange sidings depends on the maximum length of the trains running to the docks which is governed by (1) the power of the locomotives employed by the railway company and (2) the characteristics of the route over which the trains have to travel between their points of origin or destination and the docks, e.g., trains tend to be shorter over mountainous routes than over flat routes. Lengths of trains vary considerably in this country. It is, therefore, not possible to generalise but under modern conditions roads should be provided in normal circumstances in this country to accommodate trains of not less than 60-80 normal wagon lengths.

The number of tracks or roads in each exchange siding is governed by (1) the maximum number of inwards trains estimated as likely to arrive during peak periods, (2) the size of the sorting sidings, (3) the speed at which wagons can be accepted by the sorting sidings or vice versa, i.e., the time taken to transfer the wagons from the exchange siding to the sorting siding or vice versa, (4) the speed at which wagons can be sorted on the sorting sidings and worked away to their destinations in the dock.

In view of the fact that incoming trains are brought on to the exchange sidings by the railway companies' locomotives and outgoing trains by the port undertaking's locomotives, escape roads should be provided to allow these engines to be released from the exchange sidings immediately they have placed their trains.

Sorting Sidings

The sidings on which incoming trains are broken down to rakes of wagons in berth, transit shed or warehouse order, or outgoing wagons are marshalled into train, marshalling yard or station order are called sorting sidings. They are linked with the exchange sidings by a connecting road (railway track) and a road known as a shunting neck on which the actual shunting of the wagons takes place.

In order to keep wagons moving in one direction only, wherever possible, it is desirable to situate sorting sidings in tandem with the exchange sidings. In practice, however, the over-riding consideration of space frequently makes this layout impossible and such sidings have to be laid out side by side, thereby incurring reverse movements of wagons during shunting operations.

Port Operation—continued

The area covered by sorting sidings is often governed by the physical limitations of the site available. Subject to this important qualification, the number of roads in the sorting siding depends on the number of berths, transit sheds and warehouses served and on the extent to which they can be grouped. This factor in turn affects the length of the roads, which is further governed by the frequency of the trips which can be made between the siding and the berths and warehouses. It is important that the sorting sidings should be adequate to allow for the free acceptance of wagons from the exchange sidings without holding up shunting in the exchange and sorting sidings owing to roads being full.

The layout of sidings is influenced by whether they are " flat " or " gravity " operated.

Flat sidings are those which are sited on level ground and in consequence are worked in both directions by engine power.

Gravity sidings are (1) those situated on gently sloping land which enables some or all of the shunting to be performed by gravity, (2) those on which the shunting neck is laid over a hump on the ground. Shunting is performed by pushing the wagons up one side of the hump by engine power and allowing them to run down the other side by gravity into the appropriate siding.

Flat sidings are more commonly to be found in ports and docks, mainly owing to the fact that they are the more suitable where space is restricted.

Simple gravity sidings for topographical reasons are not normally suitable for dock working although great use is made of gravitation in such places as Newport and Sunderland for feeding coal exporting berths.

Where, however, there is sufficient density of traffic and land permits, the hump yard is gradually finding favour. Hump yards for dock working are to be found at Swansea and in the ancient port of Alexandria. It is interesting to record that in Calcutta, where at present sidings are designed on the " flat " principle, provision is being made by the Commissioners in their reconstruction programme for a hump yard to be laid out in the new railway sidings.

The advantages claimed for hump yards are (a) saving in engine power, (b) faster working, (c) making possible the forward movement of each wagon. The disadvantages sometimes urged are (a) the need for additional yard staff, which is uneconomical where work is intermittent (but this disadvantage can be minimised by the provision of mechanical braking), (b) wind and frost are likely to affect the speed of working to a greater extent than in flat yards (but this may be offset by providing a second hump with a greater slope), (c) the need for more space than in a flat yard.

Siding accommodation should also be provided for (a) wagons containing cargo which for various reasons, e.g., lack of transit shed space or because it is required for loading direct to ship, cannot be put to quay immediately, (b) crippled wagons (sometimes known as hospital sidings) and (c) brake vans.

Sidings should also be equipped with a weighbridge (automatic scales for weighing loaded or empty railway wagons), gauge (to ensure that wagons do not leave the dock area out of gauge, i.e., loaded too high or too wide) and watering points capable of delivering to engine tanks at a fast rate. Engine sheds should be situated so that locomotives can proceed between sheds and sidings without interfering with shunting operations. Coal stacking grounds and coal stages should be situated to provide the least interference with work in the sidings. Double-storied signal boxes, with offices on the ground floor, should be placed in positions which command a good view of the exchange sidings and other sidings where possible.

Lighterage Berths

Reference has already been made to the use which can be made of the quay space between berths for lighterage purposes. In addition to these berths special lighterage berths are to be found in some ports for the transference of cargo between land conveyance and water conveyance.

Lighterage berths are normally constructed where there is insufficient depth of water for large vessels to be worked. It would be uneconomical to use a deep water berth, except in the circumstances referred to above, exclusively for lighter traffic. Where lighterage berths are sited separately from ships berths, the quay surfaces should not be so high out of the water, to enable cargo which can be worked by hand to be walked out of or into the lighters with greater ease.

As in the case of ships' berths, rubbing bands should be provided. In open tidal waters, where the wash caused by passing craft is likely to cause a heavy swell, vertical rubbing bands are preferable to horizontal ones. In these circumstances, they afford more protection to the lighters and quay faces and further avoid the danger which arises from the gunwales of lighters catching under horizontal fendering.

Where there is a possibility of the lighters lying more than one deep, mooring posts should be provided to prevent (a) lighters drifting out into the fairway and (b) mooring ropes of outside lighters lying across the inside lighters on which work is taking place.

The general principles governing the layout of shipping berths also apply to lighterage berths in respect of road and rail services, provision of cross-overs, freedom from unnecessary obstructions on the quay, quay surfaces, lighting, transit sheds and office accommodation.

Photo by courtesy of Southern Railway

Ramped Cargo Berth at Southampton.

Bollards should be much smaller than on ships' berths, or better still, be replaced by mooring rings, which form less of an obstruction on the quay.

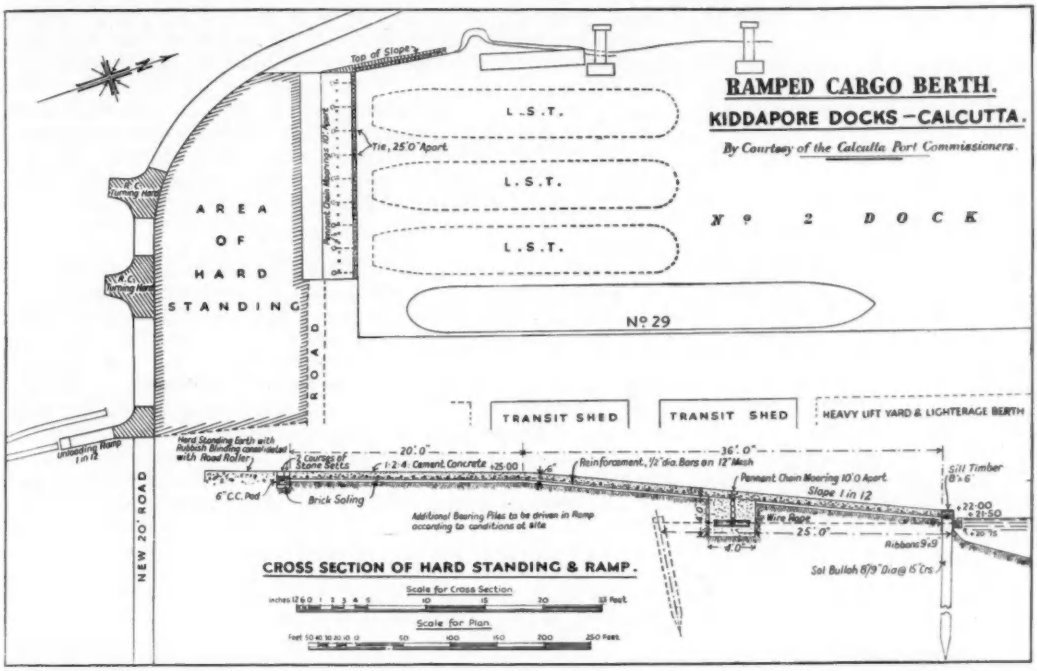
The type of crane power provided depends on the width of the berth and the type and quantity of cargo to be handled. In general, it may be said that the use of portal cranes on lighterage berths can rarely be justified on economic grounds, except where the quay is very wide and a great crane outreach is required or necessary. Travelling cranes using the number one railway road for a track, and mobile cranes, are usually sufficient for general cargo purposes. The road used by the travelling cranes should be connected with the ordinary railway track, so that the cranes can travel under their own power for duties in other parts of the dock when not required for lighterage work, or to the maintenance and repair shops when necessary.

Where travelling steam cranes are used, ample watering points, i.e., one between each two cranes, should be provided on the quay. Water carriers (vehicle) are less satisfactory.

In those places where crews of the lighters or craft using the berths live on board, canteens and cooking facilities should be provided in the near vicinity of the berth, for the use of the crews in order to avoid the danger of fire which arises from the lighting of fires on the craft while they are at the berth.

Each lighterage berth should also be provided with a heavy lifting crane which should be situated so as to avoid interference with general cargo working. A suitable site for this crane is one

Port Operation—continued


RAMPED CARGO BERTH.
KIDDAPORE DOCKS—CALCUTTA.
By Courtesy of the Calcutta Port Commissioners.
L.S.T.
L.S.T.
L.S.T.
No 2 DOCK
No 29
AREA OF HARD STANDING
ROAD
NEW 20' ROAD
TRANSIT SHED
TRANSIT SHED
HEAVY LIFT YARD & LIGHTERAGE BERTH
Top of Slope
Tie, 25'0" Apart.
Pennant Chain Moorings 10'0 Apart.
Unloading Ramp 1 in 12
Hard Standing Earth with Rubbish Blending consolidated with Road Roller
3 Courses of Stone Setts
1:2:4 Cement Concrete
Reinforcement, ½" dia. Bars on 12" Mesh
Pennant Chain Mooring 10'0 Apart.
Slope 1 in 12
Silt Timber 8"x 6"
6" C.C. Pad
Brick Soling
Additional Bearing Piles to be driven in Ramp according to conditions at site
Wire Rope
Ribbons 9"x 9"
Sal Bullah 8/9" Dia @ 6' Crs.
CROSS SECTION OF HARD STANDING & RAMP.
Scale for Cross Section
Scale for Plan.

which provides a dumping area (stacking ground) and adequate facilities for direct delivery to road, rail and craft. The provision of a dumping area is most necessary to permit of the quick release of lighters or land conveyances carrying heavy lifts (which are frequently special units incurring high demurrage rates) when the conveyances to which the lifts are to be transferred are not immediately available.

Ramped Cargo Berths

The development during the war of ships and craft fitted with a ramp in the bows, which could be lowered and raised and over which vehicles could be driven or cargo handled, brought about the necessity for constructing quays at which such craft could be berthed end-on. These berths are known as ramped cargo berths.

They consist of a quay which slopes gently (about 1 in 12) down to a sill at the dock water's edge on which the vessel's ramp can rest when lowered, in fact forming a continuation of the ramp for vehicles leaving or entering the vessel. The ramped quay should abutt on to a level hard standing of liberal proportions, to avoid congestion of vehicles disembarked or waiting to embark, which should vary in area according to the number and the size of the ships which it is possible to berth at any one time. The berth should be road served and within easy reach of rail facilities, which should include an end-on loading ramp.

It is important that these berths should be as free of obstructions as possible, accordingly mooring rings are used instead of bollards.

Lighting facilities on the same principles as those used on ordinary berths should be provided.

At most docks and wharves the water space taken up by vessels projecting out at right angles from the berth creates a siting problem. This may be overcome by constructing the berth between the roots of two jetties as at Alexandria, or at the end of a dock between two sets of berths as at Calcutta. In both designs there must be sufficient water area to allow not only for the vessels at the ramp and at the berths on each side of the ramp, but also for smaller craft required for overside working.

The layout, design and use of ramped cargo berths are worthy of the student's special attention for there is a great possibility that the next few years are likely to see important developments in the use of landing craft for commercial purposes.

Dry Docks

Dry docks are provided in ports for the purpose of carrying out repairs and maintenance to the under-water parts of the hulls of ships. Vessels also require examination in connection with their periodical surveys.

Dry docks may be divided broadly into two classes (1) those constructed on land, sometimes known as graving docks, and (2) floating docks.

A graving dock is a small dock, large enough to hold one or two ships, which may be sealed off temporarily from the dock, river or harbour water which fills it, and dewatered. The sealing is usually carried out, as already explained, by caissons. Dewatering, by which is meant emptying the dock of water, is brought about by pumping the water out through sluices set in the caissons and the dock walls.

Ships requiring to use the dry dock are floated in and the dock is sealed. Water is then pumped out. As the level of the water in the dock is lowered the ship's keel comes comes to rest on keel blocks which stretch from end to end down the centre of the floor of the dock. As the water level falls the vessel is kept in position by means of (a) bilge blocks which form a cradle, moulded to the shape of the hull, situated on each side of the keel blocks (in some docks the bilge blocks are put in position by divers and in others they are operated from the shore by power—usually hydraulic) and (b) poles (shores) placed between the hull and the sides of the dock. When the dock is completely empty of water, these bilge blocks and shores hold the vessel in position. The walls of the dock are stepped down, so that the dock is wider at the top than at the bottom.

A dry dock has been constructed at Tilbury, London, in which shores are not used. The ship is led into the dock by means of a girder mounted on a track on each side of the dock which holds the ship dead centre thus obviating the difficult manœuvring which is otherwise necessary to ensure that the vessel comes to rest on the keel blocks when the water level drops. The bilge blocks in this dock are hydraulically operated. By these means it is possible to keep the ship in an upright position without the use of shores.

A dry dock should be equipped with at least one crane capable

Photo by courtesy of "P.L.A. Monthly"

Dry Dock, Tilbury Dock, showing keel blocks, bilge blocks and Leading-in Girder at end of Dock.

Port Operation—continued

of lifting the heaviest part of the ship likely to be moved for repair purposes.

A pumping station and an engineer's workshop should be sited on the sides or at the landward end of the dry dock. A dry dock should be equipped with good lighting on the same principle as a wet dock.

Access to the bottom of the dock is provided by means of steps fitted with a good handrail.

Photo by courtesy of Calcutta Port Commissioner

King George Dock, Calcutta, showing (1) right background Entrance Lock (ship passing through); (2) parallel with entrance lock, dry docks in tandem (two ships docked); (3) ships at dock buoys; (4) Right-centre Garden Reach Jetties with coal berth on bottom right.

The number of dry docks in a port depends on the number of ships using the port, and also upon the number of ports within reasonable sailing distance also equipped with dry-docking facilities. One dry dock at least should be made large enough to handle the largest ship likely to use the port.

Reference has already been made to the problem arising from the tendency of ships to outgrow port and dock facilities. As far as ship repairs are concerned this problem has been met by building large dry docks which can be partitioned off by the use of caissons to take more than one ship at a time. It has been solved in King George Docks, Calcutta, by constructing two large dry docks in tandem, separated by a caisson and capable of additional sub-division. These two dry docks can be used as one and it is safe to assume that united they will meet shipping developments for many years to come. One difficulty arising in connection with these dry docks, and in fact with all dry docks where more than one ship is docked, is that there is only one entrance. In consequence, considerable care must be exercised in ensuring that the vessel requiring the use of the dock for the longest period is entered first and put in the compartment farthest removed from the dry dock entrance, otherwise a ship to which repairs had been completed might find its way blocked by a vessel whose state of repair was such that it could not be floated.

A further advantage of dry docks in tandem is that one workshop, one set of offices and one staff organisation will suffice for both docks.

An important strategic feature of the dry docks in tandem in King George Docks, Calcutta, is that they have been excavated parallel with the main entrance lock and so situated that they could be converted, in an emergency, into an entrance lock from the River Hooghly to the wet dock.

Floating Docks

A floating dock is a floating structure which may be used for the same purposes as a graving dock. By flooding tanks which form part of its hull it can be submerged, as required, to a sufficient depth to permit of ships being floated into it. When the ship is in position, the dock is dewatered by pumping out the tanks, until the buoyancy of the dock is such that both the deck of the floating dock and the whole of the ship on the floating dock are clear of the level of the water in which the dock is floating. The floating dock is open at each end above deck level to allow (1) water to run in and out as the dock is submerged or raised and (2) ships to be navigated in and out. A wall is constructed down each of the long sides of the dock fitted with mechanical shores which hold the ship, when she is not floating, in position in the dock. These walls are equipped with cranes and workshops as in the case of graving docks. In practice, however, it has been found valuable to have a shore base in addition.

The deck of a floating dock is fitted with keel and bilge blocks in the same way as a graving dock.

The advantages of floating docks are (1) they do not require land space, an important point where additional land is not available or expensive to acquire, (2) they can be moved from port to port if necessary (a floating dock has recently been towed in two parts from Bombay to Malta), (3) they can often be more easily altered than graving docks to meet increases in the size of ships, (4) ships can be docked or undocked without interfering with the main stream of shipping.

The disadvantages of floating docks are that they require to be anchored in comparatively calm water and they require considerable depth of water when submerged to receive a ship. Allowance must be made for (1) draught of ship, (2) water between the keel of ship and the deck of the dock when submerged, (3) depth of the submerged part of the dock and (4) water required under the floating dock when submerged. A floating dock, large enough to accommodate a large ocean-going vessel (draught say 35-ft.) would probably require up to 70-ft. of water. Where dredging is necessary to get this depth, two areas (or one large area) must be prepared in which the floating dock can be submerged to the maximum depth. In cases where considerable dredging is necessary, the creation of what are virtually deep pits on the harbour bed, often cause rapid silting and in consequence frequent dredging is necessary to maintain the requisite depth. Another difficulty about floating docks is that engineers and other operators have to be transported between the dock and the shore by boat and all materials arriving by road or rail have to be transhipped by the same means.

Slipways

Slipways are provided in many ports for vessels which are small enough to be hauled clear of the water and for which, in consequence, the provision of expensive graving or floating dock facilities is not necessary.

A slipway may be described as a recess provided with a sloping bed, leading off from the main dock or other water area. Ships requiring to use the slipway are placed in a cradle, which is then drawn by mechanical means up the slipway until it is clear of the water.

Dock Estate Boundaries

For security purposes and to comply with Customs regulations, docks are almost invariably surrounded by high boundary fences or walls, Glasgow provides a notable exception by having no such fences. Where such fences are necessary to comply with

Port Operation—continued

Customs requirements they are known as "Customs fences." Fences should be made as difficult to scale as possible, by capping them with barbed wire or with broken glass set in cement and by building them sufficiently high, say 10-ft., to prevent goods being thrown over them. They should also be well lit. Walls or fences are usually made of brick, cement or timber. Brick and cement are preferable to timber as they are less easily breached.

Walls should be built clear of trees, buildings, parking places, railway tracks, telephone, telegraph and lighting poles in fact any erection which could act as an aid to climbing over them.

Landward Entrances at Docks

The student will appreciate that if a dock estate is walled or fenced in gateways must be provided at suitable points. Gateways are required for (1) pedestrians, (2) road transport, (3) rail transport. They should be kept to an absolute minimum compatible with efficiency, and when not in use they should be locked. It is necessary for all gates to be guarded, when open, to prevent theft and the use of the docks by unauthorised persons. Gates for pedestrians and motor transport are usually situated side by side. To avoid congestion at dock exits while dock gate police or similar employees are checking the passes of vehicles leaving the dock area. considerable space should be allowed for parking vehicles waiting their turn to pass through the gateways.

(To be continued).

Additional Reading.
Modern Railway Operating—David R. Lamb, Chapter V.
Modern Dock Operation—D. Ross Johnson, Chapter IV.
Ports and Terminal Facilities—MacElwee, Chapter VI.
Port Development—MacElwee, Chapter X.
Port Studies—Brysson Cunningham.

ERRATA—In setting the caption under the illustration on page 42 of the June issue, the words "lock" 'and "dock" were transposed. The correct wording should be:—Aerial view of Kidderpore Docks showing (1) straight line layout of quays; (2) Entrance Lock; (3) Turning Basin; (4) Dry-Docks (with ships) leading into Turning Basin; (5) Vehicular Bridge between Nos. 1 and 2 Docks in open position; (6) Ships at Dock Buoys; (7) Nos. 27 and 29 Berths; (8) Ramped Cargo Berth at extreme left of Dock with L.S.T.'s berthed; (9) Railway Sidings leading to Docks.

The photograph on page 42 and the drawing on page 46 were supplied by courtesy of the Calcutta Port Commissioners.

Port of The Hartlepools

Speech at Centenary Celebrations

Proposing the toast of "The Port and Town of West Hartlepool" at the Centenary Celebrations held early last month, Sir Charles Newton, Chief General Manager of the London and North Eastern Railway, said it must indeed have been a proud day on June 1st, 1847, when the West Hartlepool harbour and dock were opened amidst great enthusiasm.

The opening of the first dock was followed by the construction of the Jackson Dock and the Swainson Dock in 1852 and 1856, and the next most important date in the history of the port was when the railway took over the Hartlepool system of docks in 1857 and the West Hartlepool system in 1865. From that date onwards the fortunes of the railway and of the Borough have been closely interlinked.

The L.N.E.R. and the traders of the Hartlepools have together developed and built up one of the great ports of the United Kingdom. Now, under the Transport Bill at present before Parliament, this intimate association may have to be severed, the railway coming under one governing body, and the docks and harbours under another. He could not see upon what logical basis this is being done. Anyone who had ever walked around one of our big ports would have been able to see the extraordinary close link-up that is needed between railway facilities, shipping berths, warehousing, cranage facilities, and all the other harbour equipment. They form, in fact, the constituent parts of the port organisation for moving, handling, storing and transhipping goods.

Now some Civil Servant in Whitehall, having a tidy mind, had taken objection to this very practical form of "integration" of transport. He had probably said: "This is ridiculous. Trains run on land, but ports serve ships which float on the water. They must therefore come under separate administrations. On the other hand, canal boats float on the water like ships, and therefore they should come under the dock and harbour executive." This mistake would be funny, were it not that the price paid by the country may be such a heavy one.

Continuing, Sir Charles said: "Let us look at the great ports of the East Coast—Newcastle, The Hartlepools, Middlesbrough, Hull, Grimsby, Immingham. Let us consider the gigantic network of railway facilities involved, the close-knit organisation for ensuring the efficient despatch of goods and their transhipment from ship to rail and vice versa; and then let us look at the connection these ports have with the canal system. It is trifling.

"Nevertheless, I believe that despite the mistakes of our administrators in Whitehall, the native commonsense of business men who know their job will make its voice heard in the end. It is no secret that the L.N.E.R. has been in close touch with the trading interests of the Hartlepools regarding the improvement of facilities at the railway-owned docks, and proposals have been worked out for two major schemes. One is an improved lightening berth in the old harbour, which will enable the port to deal regularly with vessels of deeper draught than can at present pass through the lock-gates; the second is for a new crane berth at the west side of the Central Dock. This will represent a major improvement, and the cost of the two schemes together will be in the neighbourhood of £350,000."

He thought that in normal times they would have been prepared to submit these proposals to their Board for formal approval, in the near future. Whether or not current events in the political field will delay the execution of these works, he could not say, but he could assure them that they had not allowed the prospects of nationalisation to prevent them from bringing their plans as close to completion as possible. They were confident that, whoever may be responsible for the management of the port and docks in the future, the schemes which they had worked out in close collaboration with the trading and local interests concerned would have to be implemented.

The Federation of Dredging Contractors

A notice announcing the formation of the above Federation has been received from the Secretary at River Plate House, Finsbury Circus, London, E.C.2. The objects and list of members of the new body are as follows:—

1. **Objects.** To promote any measures that may be considered advisable for the protection of interests of the members.

2. To establish amicable relations between members and their workmen, etc., and for this purpose to provide for united action by members.

3. To arrange and settle any questions arising in relation to hours of work, rates of pay and the employment of labour and apprentices.

4. To maintain a high standard of conduct, to combat unfair practices and to encourage efficiency among members.

5. To secure the adoption of model forms of contract embodying equitable conditions and to do all such other things which are conducive to the above and which promote co-operation between Dredging Contractors.

6. **Members.** The members are as follows: Harbour and General Works, Ltd.; James Contracting and Shipping Co., Ltd.; K. L. Kalis, Sons & Co., Ltd.; Nash Dredging and Reclamation Co., Ltd.; The Dredging and Construction Co., Ltd.; Tilbury Contracting and Dredging Co., Ltd.; Westminster Dredging Co., Ltd.

7. **Officers.** The Officers are as follows: Chairman: Mr. C. C. Gover, of Tilbury Contracting and Dredging Co., Ltd.; Vice-Chairman: Mr. B. J. Allison, of K. L. Kalis, Sons & Co., Ltd.; Secretary: Mr. W. H. Durlac, Chartered Accountant of River Plate House, Finsbury Circus, London, E.C.2.

Death of Distinguished Port Engineer.

Notes of the Month

Proposed Graving Dock for Dundee.

The Dundee Harbour Trust's memorandum supporting their application for a grant to assist in the construction of the larger graving dock proposed for the port has been answered by the Shipbuilding Advisory Committee. The Committee say they have given the memorandum careful consideration, but the information was insufficient for them to decide on the merits of the proposal. They have asked for further details of past and present volumes of shipping, estimates of future trade and a forecast of the amount of repair work likely to result from additional dry dock facilities. The Harbour Board has accordingly instructed the development committee to prepare a report.

Inverness Harbour Development.

Inverness Harbour Trustees, who are considering a scheme to build a deep-sea harbour for vessels of 10,000 tons, were recently informed that the lack of adequate facilities had resulted in Inverness being turned down by a large industrial firm seeking a site for a new factory likely to employ several hundred workmen. Mr. P. C. Lennox, the convener of a special committee, said that while the matter of the sufficiency and efficiency of the stevedore system should be investigated, the Trustees should also consider the provision of a deep-sea harbour with Inverness Town Council. It was agreed that a committee of the Trustees should meet the Town Council to discuss the question.

Glasgow Harbour Improvements.

As part of the ten-year plan to electrify and improve Prince's Dock, the Clyde Navigation Trust have agreed to accept contracts which will involve an expenditure of approximately £241,900 in the next two years. The improvements have been recommended by a joint committee and the scheme includes the provision of eight 5-ton electric grabbing cranes, the replacing by electric capstans of 14 hydraulic capstans on the South Quay at Prince's Dock, the provision of one 5-ton electric crane at Berth 23, additional cables, electrical equipment and other work, all at an estimated cost of £193,550. It was further recommended that at the graving docks there should be installed new hydraulic pumps and accumulators, additional cables and plug points for ship services, lighting etc., and other work, at an estimated cost of £48,350.

Improvements Planned for Port of Aalborg.

Aalborg, Denmark's most important provincial port, is preparing to become the largest loading and discharging port of the Kattegat. Plans drawn up by the Harbour Board are now awaiting Government approval and it is hoped that work will be commenced forthwith. The scheme will involve a total expenditure of 50 million kroner and is expected to take 10 years to complete; work will be carried out by Danish engineers. Construction of two kilometres of new deep water quays of a depth of 9 metres, a new East Harbour with three basins 9 metres deep, and a general cargo harbour with public warehouses is planned. The capacity of the old harbour is to be increased from the present 17,000 cub. m. to 60,000 cub. m., and the building of a new fishing harbour 5 metres deep is also under consideration.

U.S. to Study Cargo Handling.

The United States Maritime Commission have announced that it has set up a National Advisory Committee for Materials Handling at ports, the objectives of which are: (1) to define and clarify the present problems of materials handling; (2) review both favourable and unfavourable trends affecting the work of stevedores; (3) advise the Port Development Section of the Maritime Commission's Research Division relative to cargo handling studies; (4) plan and conduct experimental operations in materials handling; (5) collaborate with the Research Division's Port Development Section in making recommendations to increase efficiency. The Commission has written to the directors of all principal ports in the U.S.A., asking that they appoint local cargo handling efficiency committees.

Tyne Port Health Authority.

The Tyne Port Health Authority, which is responsible for the examination each year of 25,000 passengers as well as ships' quarters and food cargoes, recently held its 50th anniversary meeting on board the Tyne Improvement Commission launch *Sir William Stephenson*, which made a trip along the Tyne.

Progress of Shanghai Harbour Plan.

Surveying has started in connection with the two-year plan for dredging Shanghai Harbour to enable ocean liners to tie up alongside the Bund without having to depend on the tides. Under the scheme, navigation channels which have considerably narrowed owing to the accumulation of silt during the eight years of the Japanese occupation will be deepened by at least 9-ft. at the mouth of the Yangtse River. During the Japanese occupation all important harbour installations and equipment at Shanghai were seized and removed and such plant as was left was in such bad condition as to be almost useless.

Brazilian Port Improvements.

The Santos Dock Company has outlined a programme for improving the Port of Santos at an estimated cost of £6,500,000. The plan includes the construction of 870 metres of new quays at Saboò and Outeirinhos, and possibly a pier at Valongo; the erection of new warehouses; the installation of a submarine pipeline for unloading oil; extensions to silos, general store buildings and coal depositories; and extensive dredging work. Much of the new equipment has already been ordered from British, American and Swedish manufacturers.

Radio Control for Tugs.

Early in June, a demonstration was given of the Pye radio-telephone system which has been installed on tugs operating on the Tyne and Wear belonging to France, Fenwick, Tyne & Wear, Co., Ltd. Col. F. Dawson, managing director of the tug owners, said his firm were pioneers in the installation of this type of communication which would allow them to contact their vessels on both rivers within a few seconds. In the past, when a tug was sent out on a job, they were never certain when the work had been completed. It was stated that the radio-telephone had been used successfully in bad weather when the *Monarch of Bermuda* was towed from the Tyne to Rosyth.

Extensions at the Port of Rio Janeiro.

In connection with the extension of the docks at Rio Janeiro, the Director of the National Department of Ports, Rivers and Canals has stated that the piles and other material for an extension 1,300 metres in length, have been ordered in the United States, and the equipment should arrive in Rio Janeiro by next month. The new extension will be used for minerals handling, and the present work includes the installation of the imported material, filling-in and dredging. As regards the proposed construction of a Pier at Praca Maua, soundings are to be taken in order to find the best location. It is estimated that this new construction will take about two years to complete, and that, as a result, the present port capacity will be increased by 50 per cent.

River Dee Navigation.

A conference representative of the River Dee Catchment Board and local authorities in Flint, Denbigh and Cheshire was held recently to discuss a scheme for improving navigation on the River Dee. It provides for the erection of parallel training walls from Connah's Quay for a distance of 7 miles seaward, which would afford channels 20-ft. deep at high tide. The scheme, estimated to cost between £800,000 and £1,000,000, was unanimously approved by the conference and will now be submitted to the Ministry of Transport. Ships of about 400 tons can at present reach Connah's Quay, but the scheme would make the river navigable to this point for ships ot up to 1,000 tons. Flint, which was once a deep-water port would regain some of its importance to coastal shipping.

The Mudbanks of Malabar, South India

By Sir ROBERT BRISTOW, C.I.E., M.I.C.E., M.I.M.E.

Introductory

THE mudbanks of Malabar are of immemorial antiquity. Some of them appear on the earlier charts of the seventeenth century, but thousands of years before then they must have been in existence, and they undoubtedly contributed largely to the safe anchorages of the coast in the first century A.D., when the sea route from the Persian Gulf and the Red Sea became generally known through the discovery of the habits of the monsoon winds. Even at the present time three of the largest of them, two at or near Calicut and one at Alleppey in Travancore, are of the greatest value to those ports.

Their size and shape vary, but in the main they resemble a parabola with a base of about four miles or more and a seaward projection of two or three miles. Some of them stretch as far as the five fathom contour. In 1938 there were ten known banks at places from Pambalayimi, about sixteen miles north of Calicut, to one several miles south of Alleppey. The common feature of all these banks geographically is that they lie at or near the mouths of rivers, or at points where outlets to the sea are believed to have existed. But a more important feature to the seaman is that they all have the extraordinary property of tranquillizing the seas above them in the roughest monsoon weather, and thus form an absolutely safe anchorage.

For many years their composition and origin were matters of speculation rather than scientific research, but in 1937 one of the oldest of them, known as the Narakal bank, which had been slowly creeping down the coast from the mouth of the Periyar River, some sixteen miles to the north, suddenly brought up astride the main approach channel to the Cochin Harbour during the south-west monsoon and caused rapid silting. This, of course, demanded close study and led to a much more enlightened exposition of the problems of origin and habit. When I went to Cochin in 1920, one of my first acts was to visit the Narakal bank, which lay some five miles north, and to make local enquiries as to its habits. I was assured on all sides that the bank, while not stationary, always returned to its usual position, and this was corroborated by all the previous reports of which I was made aware. I had yet to learn that the Malabar Coast did not yield its secrets so easily. It was not until 1937, after watching the movements of the bank for 17 years, that I discovered, deeply buried in the archives of the Madras and the Cochin Governments, information which was both explicit and only partially confirmatory, and not until 1938, when probing the inexhaustible resources of the British Museum, that I found a chart dated 1775 showing what appeared to be, and most probably was, this same bank just south of the Periyar River itself.

Thus, the problems set by the movements of these banks were not merely academic. They had a threefold significance: (a) an apparently stationary bank lying at a roadstead in deep water might suddenly invade the beach and put the piers out of action; (b) it might travel away from the roadstead and upset all landing arrangements in rough weather; (c) it might cross the approach channel of a deep-water port and put it temporarily out of action. This last has not happened so far, but even its possibility demands rigorous care and watchfulness. In both (a) and (b) there have been many such upsets to the normal routine of the ports, some very serious.

Basic Facts.—Our first task, of course, was to discover four things: the composition of the mud, its origin, the cause or causes of its movement, and the mystery of the quiet water above it, whose stillness seemed to grow inversely with the fury of the monsoon. As to the first, we decided that the expert researches of the Rothampsted Experimental Station should be utilised from the beginning, and then proceeded to study origins. There were the usual sources to consider: (1) that the mud was the finer elements of the sea-bottom driven inshore and held there by littoral and deltaic forces, and (2) that it came from the lateritic stratum characteristic of the Malabar Coast via the rivers. After much discussion, we decided to leave this also for the present. Quite possibly it might be a combination of both. We therefore concentrated on the *cause* of the movements, and this entailed a most absorbing study of contours north and south of Cochin harbour, the known progressions of the banks, the rainfall, and exceptional storms and earthquakes over a century—from 1835 to 1938, to be exact. This was all set out in tabular form, so that the various phenomena could be studied side by side in every few years, with the authorities given for each incident. Fortunately, the data from Government sources proved sufficient. We had the tracks of every cyclone from 1845, the rainfall intermittently from 1842, and for every year after 1864, the mudbank positions at several periods—some of them provided and others confirmed by private recorders—and the seaward contours from eight charts dating from 1835 onwards, two of them our own surveys.

A detailed examination of all this material yielded certain broad conclusions: first, and most important, that from 1847 to 1879 there were no recorded shocks or cyclones, **and, during that time, no recorded movements of the banks.** (In 1861, the Master Attendant at Cochin had formed the opinion that the Narakal bank was stationary, and this was confirmed by another observer, a civil engineer, in 1871.) Second, that after an earthquake (even as far distant as the extreme north of India), a tidal wave or disturbed seas reached Cochin and Calicut, as well as Alleppey and even the backwaters south of it. Third, that a cyclone whose track lay several hundred miles away would send heavy seas to the coast; and fourth, that the north to south littoral drifts (from, say, October to March) were appreciably stronger in some years than others. Finally, the rainfall, which had a direct bearing on the discharge from the Cochin backwaters, might have a contributory effect at that port in delaying a southward movement of the Narakal bank.

From this detailed examination and these broad conclusions, I drew the inference that ocean or seismic storms would *disturb* the mud, and that littoral drifts would then *move* it, but having regard to the need and practical importance of finding a more definite cause, I asked the Government of India to appoint a Consultative Committee in London, consisting of one very experienced civil engineer and two geologists, one of them retired from the Government of India Survey and the other at the Rothampstead Experimental Station. Our own drawings and Blue Books formed the basis of the enquiry.

After several months' research and experiment, the committee filled in the blanks. The composition of the mud was proved to be that of the lateritic hinterland, which was thus also its origin. The causes of bank movements were broadly those which are stated above, and the mystery of the quiet water due to three causes:

(1) The unique fineness of the mud and its high viscosity in suspension;
(2) The projection of the toes of the banks over the flatter contours of the sea-bed which, in heavy weather, are instantly attacked by the ground swell in its effort to restore normality of contours:
(3) The raising of a jelly-like barrier over the toes in which two forces are at work: one near the surface, due to the kinematic viscosity of the mud suspension, and the other near the bottom, known as the " thixotropic drag." Both these ensure tranquillity within a " transition " zone, shoreward of which the sea becomes as calm as a lake on a windless day.

In addition to these results, however, it came out in evidence that the movements of the mudbanks might be a vital factor in the otherwise mysterious alternations of erosion and accretion over the sandy beaches of the coast. There was evidence which at least suggested, as a working hypothesis, that the travel of sand

Mudbanks of Malabar, South India—continued

by wave propulsion over a beach would naturally stop when a mud bank intervened, and thus the next beach would be robbed of its " compensating " sand and suffer erosion. When a severe disturbance and a strong littoral drift moved the mud elsewhere, the scene of erosion would shift also. This theory was applied to several cases where the facts were known, or half-known, and appeared to be supported by them, but the stress of war prevented further research.

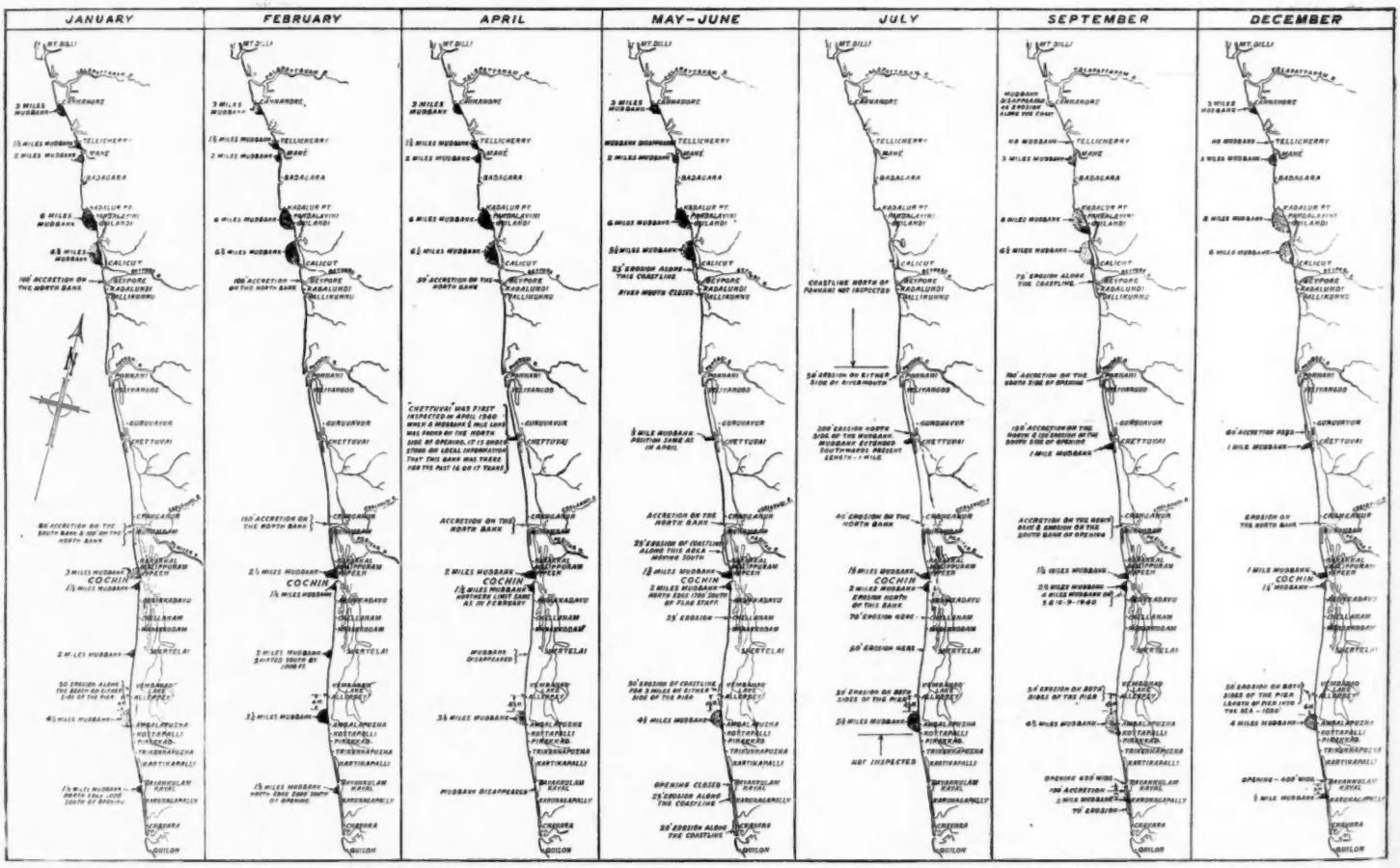
Such are the broad aspects of the problem of the Malabar mudbanks. The many rivers and streams of the west coast bring down sand from the gneiss and the finest conceivable particles from the laterite. These settle round the mouths of the rivers, come under great natural forces, and begin their journeys. More sand and mud come down, and, over long cycles, mud banks come and go, and beaches gain or lose. And sometimes a harbour engineer, in the midst of multifarious duties, has a problem to face which is fraught with the gravest possibilities administratively, as I will relate.

On page 270 of the March issue of *The Dock and Harbour Authority* will be found a reference to the deepening of the Cochin approach channel as a precaution against excessive silting. From then onwards it was noticed that there was a tendency for the silting to increase as the Narakal Bank crept nearer the port, and, in the early months of 1937, we decided to extend the Muttancheri mooring channel inside the harbour further south in order, if possible, to increase the tidal flow, especially on the ebb tides and in the maximum monsoon freshets, thus strengthening the scour out to sea. (In addition, we needed the sand which we dredged and pumped into the reclamation.) This year (1937) was momentous in the life of the port, for it was in July that the Narakal Bank invaded the channel and filled up our reserve of extra depth in a few weeks.

Not only so, but there came a turning of the tables which no one had foreseen. Our newly lengthened channel inside the harbour was to perform a strange function. Between June and October, 1937, an enormous quantity of the outer silting was carried *into the harbour by the flood tide*, probably as much as 300,000 cubic yards in the lengthened portion and a much greater quantity in the turning basin from which the extension started. Thus, by the deepening of the channel outside and the extension of the channel inside, the port was undoubtedly saved from a major catastrophe.

By October, 1937, conditions had become stable again, but the minimum depth in the outer channel had been reduced from about 39 feet to 28 feet at dead low water springs, measuring to the top of the light silt. That season, therefore, brought another great anxiety. The Bibby Line passenger vessels, drawing 30 feet aft on their homeward journey, were due every fortnight, and by great good fortune came in the evening during the higher neap tide periods when there was never less than 2 feet on the tide gauge, so that the ships suffered not even an hour's delay waiting for tides on any occasion. Of course, the top mud was very liquid, or we should not have risked such a close margin, and, of course, the mud itself rendered the approach channel *absolutely smooth*. But had the low water springs been running instead of the higher neap flood tides, we should have been obliged to wait six hours for the spring floods or take the passengers out to sea in the tug, which nobody wanted, and which would certainly have injured the port's reputation. Moreover, on the neap floods all the water was *salt;* on the spring ebbs it

Coastline from Cannanore to Quilon showing Mudbanks, Erosion, etc., 1940



Special Note—In every case, the "length" of mudbank has been given as corresponding with the visible smooth water, and has not been determined by examination of the soil itself. No doubt, the *thickness* of the mud layer will vary from time to time.

Mudbanks of Malabar, South India—continued

would have been largely *fresh*, and this would have added another six inches to the ships' draught. General Sir Frederick Morgan has recently written of the miracles of Dunkirk, D. Day, and other inexplicable chances of weather and incident. We certainly passed through a similar experience with the movements of the Narakal mudbank, and I have often recalled the urgent convictions which forcibly impelled us to deepen the outer channel and to extend the inner one, thus distributing a large part of that formidable invasion over an area of about 300 acres without stopping the work of the port for a single hour, but **without foreseeing the actual mode of invasion.**

Another extraordinary coincidence lay in the fact that out of all the factors predisposing the movement of banks over the century 1835-1935, more than one third of the cyclones and nearly one half the earthquakes in India and Burmah occurred during the progress of the Cochin Harbour works. In all, there were eight cyclones, at some distance, out of 22 recorded during the century, and eight earthquakes out of 17. Five of the cyclones occurred in 1920-1922 and three in 1931-1932. We had a tremendous disturbance in the Bihar earthquake of January, 1934, and the worst cyclone known soon after my departure in 1941. Moreover, in 1924 the rainfall was the highest ever recorded, following the five cyclones of 1920-1922. **The point of interest to all harbour engineers is at once obvious: there was nothing in the records in 1920, when the work started, to give any indication whatever as to the intensity and inter-connection of the natural forces which were to gather against us.** Had I known in 1920 what I knew in 1941, I sometimes ask myself: Should we have been justified in going on with the work? That we " got away with it " is another of Sir Frederick's miracles, perhaps, but we started confidently and in good faith on the data available, and we never " let up " for a day when the fight was on. A good staff and good plant did the rest.

We pass now to the historic and economic significance of these mudbanks. We have no record of Indian and Arabian trade with Malabar in the pre-Christian era, although we know that it existed and that the Moplahs (Mappilas) of Calicut were in that region at least 500 or 600 years before Mohammad lived. Somewhere in the region of what is now Mangalore lay the island of Nitrias, the haunt of pirates. In the early centuries of the Christian era the ports of Malabar were, from north to south, (1) in the vicinity of the Beypore River, south of Calicut, Tundis (or Tundi, or Tyndis, or Tyrtis); (2) Muziris, or Muyiri of Muyiri-Kotta, now Cranganur; (3) Bacare or Porkad, south of what is now Alleppey; (4) another port called Nelcynda or Nelkunda, not far from Alleppey; (5) Kolum, somewhere near Quilon. There were outlets to the sea and mudbanks at all these places.

The class of trade was similar and it was concentrated chiefly at Becare and Muziris. The *imports* were: " Great quantities of specia; gold stone, chrysolite; small assortment of plain cloth; flowered robes; stibium, pigment for the eyes, coral; white glass (?), copper or brass; tin, lead; wine, but not much; sandarach (sindura); arsenic (orpiment), yellow sulphuret (sic) of arsenic; corn, but only for ship's company." The *exports* brought down to these regional ports were: " Pepper in great quantities (' pepper of Kottonara '); pearls in great quantities; ivory, fine silks; spikenard from the Ganges; betel; diamonds; jacinths; tortoise-shell from the ' Golden Island ' and another sort which is taken in the islands which lie off Limurikê " (vide p. 137, " Periplüs of the Erythræan Sea "). To which might be added from another source: Rice, ghee, oils, honey, cotton, muslins and sashes.

The unique importance of the mudbanks in relation to the monsoon winds is now apparent. A vessel from China would get a fair wind across in the N.E. monsoon and a perfectly calm anchorage at any period of the year. The S.W. monsoon would blow it back. Vessels from Egypt and Persia could choose their time, avoid the roughest months, and, whatever the state of sea on arrival, could likewise anchor in a perfectly calm haven as safely as if they were moored up in a wet dock. Given a climate which could produce pepper, and a geology which would yield precious stones, a luxurious Mediterranean trading centre, a favourable dispensation of winds, a lateritic soil, which automatically provided sea harbours, and, behind the banks of rivers, stored water in its vescicles, an abundant rainfall, all manner of fish and fruit—and what more was needed to make Malabar a great emporium, as it undoubtedly was?

The unit of freight was the talent or amphora, about one-fortieth of a ton in weight. The largest ships carried 10,000 talents, or 250 tons. Both talent and amphora represented one cubic foot of water. The Greek or Roman foot was .97 of an English foot, so that the weight of each unit was nearly 57 lbs., and 40 units, nearly enough, our ton. Also, four units gave us our gallon. A more ordinary sized vessel would probably not carry more than 150/200 tons or draw more than ten feet. The coinage used was the Roman denary or the Greek drachma, both worth in more modern times (1880) about eightpence ha'penny or ninepence. Many of these coins have been found at Cranganur and elsewhere. The unit of distance was the stadia, which is practically identical with our cable, or one-tenth of a sea-mile.

We must leave this fascinating period and consider the political and commercial problems which the mudbanks at Alleppey and Calicut have created, as they affect the Port of Cochin, which is between the two. It has been shown that the banks, while giving valuable anchorage, are themselves subject to movement north or south; in addition, they are sometimes driven inshore and so block up the landing piers, which at the outer end are generally in about 15 feet of water at half-tide. This happened at Alleppey in 1928 and at Calicut in 1937 and many times before then in living memory. Moreover, the bank may leave its normal position and travel so far north or south of the piers as to give them no lee, and entail the use of tugs for handling the lighters to and from the ship, besides greatly increasing the difficulty of unloading them on shore—the ship itself having followed the mudbank to its new position. These vagaries may have been of less consequence in the earlier centuries, but any port suffering from them to-day, however seldom, may well be apprehensive of the effect of an interior port within easy communication range, either by rail or road, or by canal or backwater.

Moreover, as we have shown, both these roadsteads are so deeply rooted in the past history of Malabar, and even before then in the earliest voyages of the Arabians, that there has grown up an economic, social and political complex which is highly sensitive to competition. But, more than this, Alleppey is in Travancore and Calicut in " British " India. Both before and after Cochin Harbour was developed, the Travancore Government, so far as Malabar was concerned, was as much a " maritime " state as British India, and with all the customs and excise implications which follow; and although the actual customs arrangements were modified in the Cochin agreement, the principle of maritime rights remained, very largely dependent on a rather wayward mudbank —but of what importance! Again, from Calicut there is a good rail service to the hinterland entirely owned now by the Government of India, so that not only does that Government take all the customs dues at the port (instead of only a portion of them as at Cochin), but it takes the proceeds of the *whole* of the railway earnings, whereas the line to Cochin Harbour runs for 62 miles through Cochin State, whose Government takes the profit. Consequently, the Calicut mudbank creeps into the picture again and holds its ancient power to attract authority. And the development of Cochin had to battle with all this. No wonder that we had difficulties other than engineering ones.

What of the future of these banks? This indeed opens up a disturbing problem. As things are to-day, with cut-throat competition for trade between the nations, **it must be that the maintenance of the deep approach channel at Cochin is the cornerstone of Malabar economy.** It is that, and that alone, which places Cochin in the same category as the few other major ports of India, in that it gives an absolutely stable harbour accessible at all times of the day and night, in every season and in every form of bad weather. Next to that, the provision of wharves, cranes, railway sidings and communications and an excellent water supply clearly point to Cochin as the main entrepôt for Malabar

Mudbanks of Malabar, South India—continued

trade. But the maintenance of the approach channel is in the highest degree a specialised operation: it demands a good deal of imaginative foresight and much experience in the staff-work, a dredging unit and a pipeline both exceptional in design, and a staff of engineers and dredging operatives well above the average crew in experience, reliability and endurance. A few bad appointments, a letting-down of authority and discipline, a fire on board, a careless superintendent on the mechanical side, a parsimonious attitude towards proper adjustments in scales of pay—all these place the existence of the harbour in jeopardy, and it is extremely difficult to make a non-technical secretariat understand their full significance. Similarly, the equipoise of the commercial and political factors is delicate and in some ways unique, and India itself cannot yet be said to be in stable equilibrium.

Not only so, but India does not grow enough food to feed herself (nearly half the freight at Cochin consisted of rice), and the food supply of the whole world is in jeopardy, not merely to-day and tomorrow, but for a long time to come, owing to soil erosion and soil deterioration. In Europe, in America, Africa and Canada, in Australia and New Zealand, in India and elsewhere, the prospects are really grave. It is even possible, too, that the industrial age and the growth of its vast towns and districts has reached its peak, and that the next half-century may witness strange changes in the agriculture and overseas trade of India. On the other hand, none of these things can affect the Malabar mudbanks, nature's own gift to Malabar, and renewed from age to age.

[We regret that owing to lack of space we have to omit a long list of acknowledgments made by the Author, but we hope to print them in another publication later.—Ed.]

New Dredger for Port of Madras

Messrs. Wm. Simons & Co., Limited, the well-known Clyde Shipbuilding and Engineering firm, recently launched from their Renfrew Yard, a twin-screw side suction hopper dredger for service at the Port of Madras.

The new vessel was named *Sir Godfrey Armstrong* and the ceremony of naming the vessel as she left the ways, was performed by Lady Armstrong, the wife of Sir Godfrey Armstrong, who retired a few years ago from the position of Chairman of the Madras Port Trust. This vessel is to replace the present dredger *Madras*, built by Wm. Simons & Co., Limited, in 1904. From this it will be noted that the firm's connection with India dates back for 43 years; in certain other instances the firm's connection with the Indian States date back for a very much longer period. Indeed, it is known that vessels built by Messrs. Wm. Simons & Co., Ltd., well over 60 years ago, are still in commission in the East.

The new dredger has been constructed to the order of the Madras Port Trust in accordance with the specification drawn up by Messrs. Rendel, Palmer & Tritton, Consulting Engineers of Westminster, whose connection with India dates back as far as that of the builders.

The vessel is of slightly larger dimensions than the original *Madras*, but limited to a deadweight of 1,000 tons, in order that the original slipway built for Madras may still be used, the design has been modernised where possible, in accordance with the latest practice in the marine dredge-building industry, with trailing side suction pipes arranged to deliver into the hopper, the salient features which gave the original vessel its robust strength and long service, still being retained. Welding has been adopted to a certain extent in the construction, but only where it has been tried and proved by the builders to have equal strength and equal life as compared with earlier construction methods.

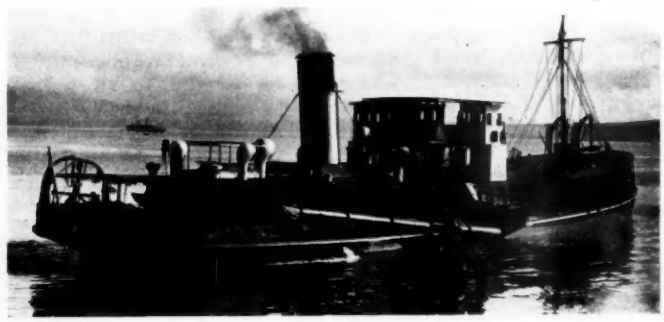
The dredger normally works to moorings, the material dredged being mainly sand at 20 cub. ft. to the ton, but varying from fine silt to coarse sand. The dumping ground is approximately 3 miles out to sea, the dredger being required to make two round trips per working day of 7 hours. To achieve this object the dredger has to fill to her marks in 30 minutes and to maintain a load speed of 9 knots.

The hopper is constructed with longitudinal and cross girders to maintain strength continuity, the doors are raised and lowered by a draw bar operated by electric hoist winches, and are slightly above base line to protect them against possible grounding. The hopper is fitted with a specially-designed longitudinal perforated tray to facilitate the rapid settling of the spoil.

The principal dimensions of the vessel are:

Length B.P.	198-ft. 0-in.
Breadth, Moulded	37-ft. 0-in.
Depth, Moulded	15-ft. 3-in.
Loaded Draft	12-ft. 5-in.
Hopper Capacity	18,520 cub. ft.
Speed	9 knots.

The twin-screw main propelling engines, also built by Messrs. Simons, are of the normal triple-expansion inverted direct acting type, with surface condenser of 2,300 sq. ft. cooling surface common to both engines, each engine developing 500 i.h.p. Cylinders are 13-in. by 20½-in. by 34½-in. by 22-in. stroke, designed to develop their full horse-power at 150 revs. per min. Brown's Steam Hydraulic Reversing Gear has been fitted.



The new dredger undergoing Dredging and Propelling Trials.

The steam to operate the vessel is supplied by two cylindrical multi-tubular marine type boilers 11-ft. 9-in. diameter by 14-ft. long, each having 2,400 sq. ft. heating surface with a working pressure of 180 lbs. per sq. in. Each boiler is fitted with two "Brundritt" patent circulators and has three Deighton type withdrawable furnaces.

The dredging is carried out by two pumps, the engines of which are exactly the same dimensions as the propelling engines, so obviating the carrying of a multiplicity of spares. Each pump and engine is capable of operating independently or in parallel. The pump casings are of fabricated mild steel construction, the impeller shafts being fitted with special sealing rings; the cast steel impeller is 6-ft. in diameter, with four blades specially constructed for building up when worn. Each pump an engine thrust is taken on a Mitchell type thrust block specially designed for the dredger by the makers.

The 20-in. suction pipes are suspended over each side of the vessel and are each connected to the hull about midships by a radial joint. Half-way down each suction pipe there is a flexible joint, thus enabling the vessel to work in rough water. These suction pipes are raised and lowered by means of electrically-driven winches and are fitted with depth gauges so that the operator may know at what depth he is actually dredging. The pipes are so arranged that the drag heads may be readily removed and replaced while the vessel is afloat.

A complete system of auxiliary machinery is provided in the engine room of the vessel. Among other things, this comprises two large steam electric generators and one small Diesel electric generator. All deck winches, capstans and windlasses are driven by electric motors, the power for which is obtained from these electric generators which are sufficiently large to provide an ample supply of current.

Dredging and propelling trials were carried out very satisfactorily, the vessel attaining a speed of slightly over 10 knots with a full load, her service requirement being 9 knots, as already stated. She will sail for Madras from the builders' Renfrew Works after taking on board the necessary stores and bunker fuel.

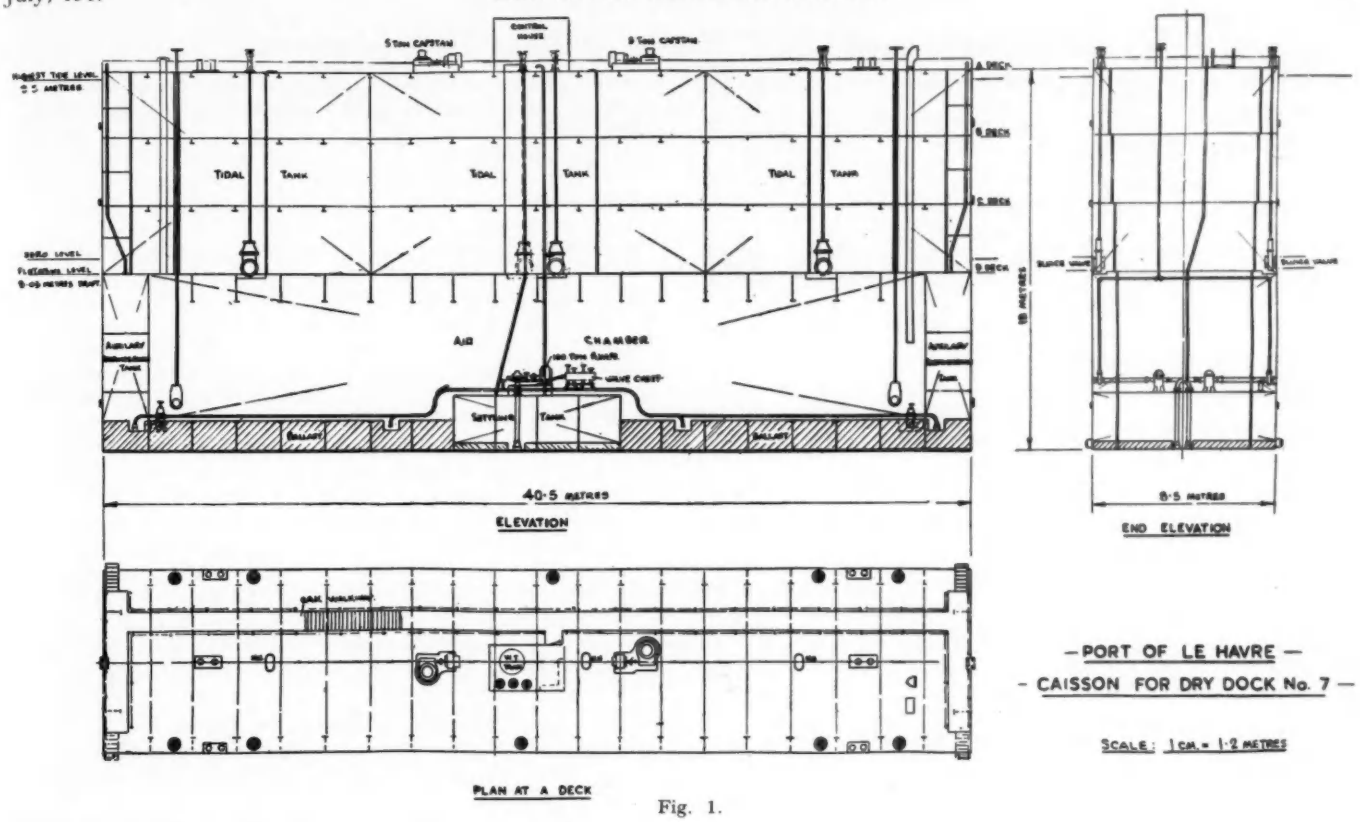


Fig. 1.

Floating Caisson at No. 7 Graving Dock, Le Havre

(Contributed).

General Description

When the Germans were driven from Le Havre in 1944 they wrecked the port, and its reconstruction has been proceeding rapidly since the beginning of 1945.

The large dry dock—No. 7—was rendered useless by placing six mines in the dock walls, by mining the Caisson at the entrance, and by scuttling two ships and a dredger in the dock.

The new entrance Caisson, built by Vickers-Armstrongs, Ltd., at Barrow-in-Furness, is shown in outline in Fig. 1. It is of welded construction and contains, in succession from keel to top deck:

A settling tank placed centrally in the permanent ballast chamber;

An air chamber housing the settling tank pumps;

Two auxiliary preponderance tanks, placed at the ends of the air chamber, and designed to maintain negative buoyancy at all states of the tide;

Tidal tanks above the watertight deck D.

The main particulars are:

Length	132-ft.
Height, keel to top deck	58-ft. 10-in.
Beam	27-ft. 10-in.
Normal draught	26-ft. 6-in.
Displacement	2734 tons

The greenheart clapping sills and vertical side keels, forming the seal, are faced with matting woven from 3½-in. tarred hemp ropes. This matting is secured to the greenheart timbers by galvanised clout-nails.

Mode of Operation

1. Sinking.

The Caisson empty of all water floats at 8.05 metres draft.

The working tide level is assumed to be + 8.5 metres.

Assume the Caisson to be in its "out" position ((4) in Fig. 3) and that it has been sunk to within 1.2 metres of its grounded position. In order to perform that operation the sluice valves to to the tidal tanks must be open and about 100 tons of water admitted to the settling tank, after which the valves to the end tidal tanks are closed.

The Caisson is then hauled into position opposite the dock ((5) in Fig. 3) by means of the capstan installed on the southern quay of the dry dock. The valves to the end tidal tanks are then opened.

By admitting more water into the settling tank (about 11 tons), the Caisson can be almost grounded and then hauled up against the sills by means of the electric capstans installed on board.

The tidal tank valves on the dock side of the Caisson are then closed.

By flooding the remaining space in the settling tank (about 15 tons) and flooding the two auxiliary preponderance tanks (about 111 tons each) approximately 84 tons of preponderance can be obtained. This takes account of the buoyancy of the layer formed by the keels (about 153 tons) when the dock is empty. This preponderance makes it unnecessary to rely on friction between keels and sills to counteract excess buoyancy.

2. Raising.

Before the operation of lifting the Caisson and before the dock is flooded the auxiliary preponderance tanks are emptied by draining into the dock. This can be done in about 20 minutes.

In order to raise the Caisson 1.2 metres, water (about 26 tons) is pumped out of the settling tank by using one of the pumps for about 15 minutes, and the valves to the end tidal tanks are shut. The Caisson can then be hauled into the out, or stowing, position.

For a working tide level of + 7.0 metres the preponderance would be about 13 tons more if the settling tank were full. In this case, to raise the Caisson 1.2 metres about 39 tons of water would have to be pumped out, one of the pumps being used for about 23 minutes.

In the event of a failure in the power supply to the pump motors the Caisson can be raised by draining the auxiliary preponderance tanks into the dock, flooding the dock, and draining the tidal tanks as the tide falls. The tidal tank sluice valves are then closed, and the rising tide will raise the Caisson with the tidal tanks acting as an air chamber.

Floating Caisson at No. 7 Graving Dock, Le Havre—continued

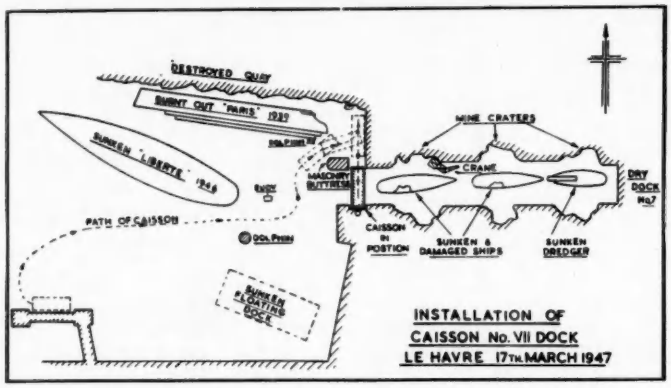


Fig. 2. General Plan of No. 7 Graving Dock and approaches.

Power Supply

Power and lighting are conveyed to the Caisson, through 55 yards of flexible shore cable, at 220-volts, 3-phase, 50-cycles. The length of this shore cable is determined by the movement of the Caisson between its " out " and " in " positions.

Machinery and Valve System

A distribution and fuse box is fitted in the Control House on " A " Deck to feed the lighting circuits for the Walkway on the top deck, the Control House and the Air Chamber.

The controllers for the pumps are fitted in the Control House, and those for the two electric capstans on " A " Deck are fitted adjacent to the capstans. Each capstan is capable of exerting a direct pull of 5 tons at 40-ft. per minute and is driven through worm reduction gearing by a 23 h.p. motor at 570 r.p.m.

Two electrically-driven centrifugal pumps are placed in the Air Chamber, each pump being capable of discharging 100 tons of sea water per hour against the maximum head. The driving units are A.C. Squirrel Cage Induction motors, totally enclosed and fan cooled, operating at 1,450 r.p.m. full load speed. They are controlled by " direct on " starters with push-button control from the Control House.

The valves on the pump discharges and that to flood the settling tank are also controlled from the Deck House.

The upper end of the watertight trunk giving access to the Air Chamber is within the Control House. Ventilating pipes, of 10-in. bore, are fitted from the Air Chamber to the top deck, a revolving cowl being fitted at the top of the supply pipe and a mushroom vent at the top of the exhaust pipe.

One 24-in. diameter sluice valve is fitted to each side of the Caisson in way of the central portion of the tidal tank, and one of 21-in. diameter on each side in way of each end portion.

Two 12-in. bore dock supply pipes with sluice valves are carried through the Caisson, one at each end and 7-ft. 2-in. above the bottom of the keels.

For manœuvring and mooring purposes bollards and roller fairleads are fitted on the top deck.

Ballast

Approximately 1,700 tons of concrete and steel ballast is stowed in the bottom of the Caisson, the steel content being such that the density of the ballast, as a whole, is not less than 300 lbs. per cub. ft.

About 20 tons of cast-iron blocks are provided for adjustment if required.

Launching

The Caisson was built on a slip and launched on its side, being up-ended afterwards by the addition of the permanent ballast.

Stability trials were then carried out.

Situation at Le Havre

It will be recollected that the ss. *Liberte (ex-Europa)* broke from her moorings during the violent southerly gale of 8th December, 1946, collided with the wreck of the ss. *Paris* and grounded, in an upright position, in the tidal basin. Fig. 2 shows the situation after this disaster, and gives some idea of the destruction done by the Germans in the neighbourhood of No. 7 Dock.

The sinking of the *Liberte* made it a matter of urgent necessity to close the entrance to No. 7 Dock at the earliest possible moment so that the dock could be pumped out, cleared of obstructions and the walls repaired in order that the *Liberte* could be dry docked when raised.

To meet the urgent request of the Port Authority it was decided to complete one working face only of the Caisson before delivery, leaving the clapping sill and vertical keels on the other face to be fitted later at Le Havre. This decision also meant that the Caisson would have to be delivered without waiting for the electric motors required for the pumps and for the warping capstans. In consequence a modified method of installation, shown in Fig. 3 and described below, was adopted.

Voyage—Barrow to Le Havre

The Caisson left Barrow, in tow, on 25th February, 1947, and reached Le Havre on the night of 12th March, 1947, after an eventful voyage in heavy easterly gales. The tow parted south of the Lizard at 14.45 hours G.M.T. on 3rd March, after which the Caisson was adrift until the tow was re-made with the second bridle, north-west of the Scillies, on 7th March. The Caisson was secured at midnight on 12th March, to the jetty at Le Havre, from which the ss. *Liberte* broke away in December, 1946. A tug was kept standing by until the manœuvre into position on 17th March.

Condition of Caisson on Arrival

Examination in daylight on 13th March revealed extensive damage on the top deck. Half the tidal tank valve fittings were destroyed or useless; the settling tank valve fitting (in the stove-in Control House) was out of line; the dock supply valve fittings were destroyed or out of action and 35-ft. of the sealing matting on the clapping sill timbers was missing.

It was decided at once that no valve must be opened until the Caisson was " home," as with bent valve spindles it would probably be impossible to arrest the sinking operation at will.

A steel foot bridge spanning the water at one point of the Caisson's passage to its final position was cut through at both ends and removed by the Port Authority. This made it possible to get home without any partial sinking of the Caisson.

Preparations for Installation

Apart from complete internal and external inspection, these included making a stage on which to lower two divers to the clapping sill timbers; the making of the 35-ft. of replace sealing matting; making a removable steel frame to hold the matting in position; clout-nailing the matting under water to the greenheart sill timbers and removal of the frame; the provision of suitable and handy fenders; the provision of wires, snatch blocks, handy-billies, and bars for the hand capstan at the south of the entrance recess.

Everything was ready by the afternoon of Sunday, 16th March.

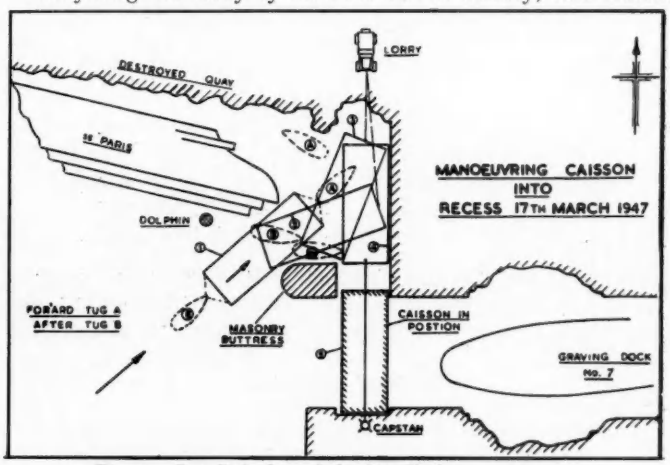


Fig. 3. Detailed plan of the installation manoeuvre.

Floating Caisson at No. 7 Graving Dock, Le Havre—continued

Installation

Fig. 2 shows the planned route to the dry dock. Direct entry was just possible but too risky as the action of the wind and tide might have produced a disastrous jam between the masonry buttress and the south wall of the entrance.

The route chosen in December, 1946, and confirmed from charts in early February, 1947, gave 10-in. of margin below water between the buttress and the wreck of the ss. *Paris* There was ample depth at all states of the tide.

The manœuvre to position on the morning of 17th March was effected on the ebb and in a patch of calm weather.

Fig. 3 shows the manœuvre to position in detail. As anticipated the leading tug A could do no more than escape from being crushed and sunk after a position between (1) and (2). The move to (3) and (4) was completed by a very heavy lorry, in reverse, while tug B nosed in gently.

At position (4) the towing brackets (for the voyage out) were cut off by flame then the haul to within about 5-ft. of position (5) was done from the hand capstan on the south side of the entrance. A diver was sent down for final examination of the dock sill and the clapping sill sealing matting. The Caisson was then hauled to its home position (5) and made fast.

A pause was made at this stage until low water in order to leave a minimum to pump out of the dock.

At low water the three tidal tank sluice valves on the west side were opened. Three motor boats were brought up on the west (tidal basin) side ready to push the Caisson against the masonry and sill.

The settling tank valve was opened with some difficulty and the Caisson began to settle, slowly at first, as the buoyancy of the air chamber was overcome. As the Caisson sank and the tidal tanks flooded, the motor boats came into action and remained at full speed ahead till the Caisson had grounded.

The preponderance tanks were then flooded.

Finally, the settling tank valve was closed, the preponderance tank valves were shut, and the tidal tank sluice valves on the west side left open.

Time Taken:	hrs.	mins.
Tow to " narrows " between buttress and *Paris*	0	45
Through " narrows " to stowing position ...	0	45
Cutting off towing brackets	0	15
Haul to near working position	0	25
Divers examination of sill and clapping sill ...	0	20
Haul to working position	0	10
Securing in working position	0	5
Sinking, at low water	0	40
Total time	3	25

Pumping Out Dock

This began as soon as the Caisson had been sunk. Owing to the possibility of collapse of the damaged walls pumping was deliberately slow. The level in the dock was lowered by 6 metres on 17th March. Wall drainage during the night raised the level by 1 metre.

At 10.00 hours on 18th March pumping was re-started and this dock, which is 1,045-ft. long, was empty at 15.00 hours. A quarter of the pre-war pump capacity was available.

The seal was excellent, the only leak being small and through a temporary repair to the mine-damaged masonry at the south side. This can readily be made good as the dock is now dry.

The accompanying photographs show the Caisson at various stages of the installation.

It is of interest to add that the ss. *Liberte* was raised on 16th April, and, after removal of the wrecks, was docked on 2nd June, 1947.

Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Shows caisson in tow approaching the " Narrows " between sunken "Paris" on the right and masonry buttress on left. Stern of s.s. "Liberte" (ex-Europa) in right background; Fig. 5. Shows the caisson, drawing 26-ft. 6-in., passing between the " Paris " and masonry buttress, s.s. " Liberte " in background; Fig. 6. Shows the caisson safely warped into recess or "out" position. Graving dock on right.

Fig. 7. Fig. 8. Fig. 9.

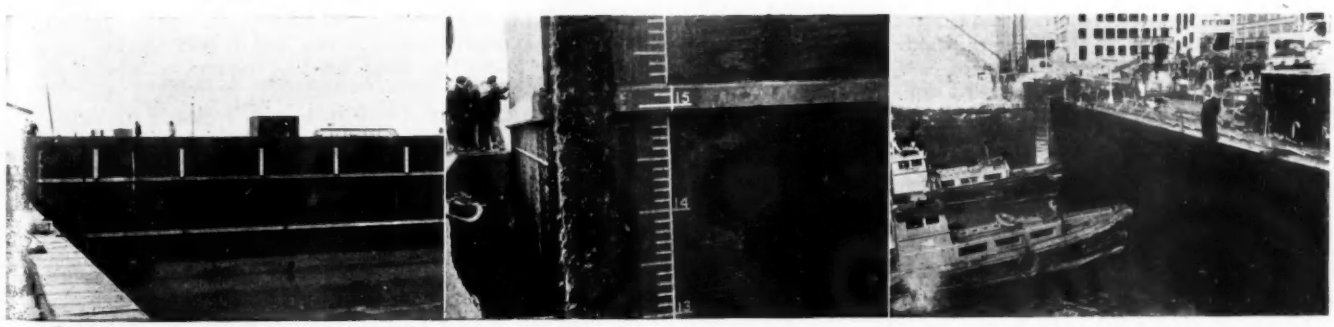


Fig. 7. Shows caisson being hauled across Dock entrance preparatory to flooding down; Fig. 8. Shows south end of caisson almost home across Dock entrance. View also shows details of hemp matting secured to vertical greenheart keel, heavy layers of bitumastic paint and welding; Fig. 9. Shows motor launches keeping caisson up to the Dock sill during the initial flooding down operation which finally closed the Dock and allowed pumping to start.

Sea Encroachment at Tramore*

By J. P. QUIGLEY, B.E., A.M.I.C.E.I.

Introduction.

Tramore, Co. Waterford, shows four diverse types of coast. To the west of the town, the high ground slopes gradually to the steep and indented cliffs formed of lower Silurian slate interspersed with a hard igneous rock rich in silica. On the flank of these cliffs, seaward from the town, is an almost vertical face of boulder clay, sixty feet high, which diminishes eastward to join the primary sea wall. Eastward beyond the first wall lie the second and third walls, each stepped landwards due to the erosion that had taken place in the interval between building. Seaward of these walls the great sweeping arc of Tramore strand, almost three miles in extent, commences. Further on, the strand is backed by a shingle storm beach. The crest is 5-ft. above high spring tide (16.0. O.D.), the base width is 200-ft., and it is 1,300 yds. long. This is followed by sand dunes. These stretch as an enlargement of the spit for a mile further to Rinnashark, where an inlet permits the tide to come and go over a salt marsh area of 2,000 acres lying to the north. On the East, West and North of the salt marsh are the remains of three sea banks which, until 1912, protected a reclaimed area of nearly 500 acres.

The Tramore area has suffered much from erosion. The sea wear of the cliff faces is relatively slow and in general occurs spasmodically and locally, but its severity is shown by the great number of arches, stacks and needles fronting the cliffs.

The area has sunk considerably in post glacial times, as is shown by the occurrence of a large turf area beneath the strand. This subsidence may, perhaps, still be in progress.

The author estimated that the approximate average rate of erosion per annum increased from 1-ft. at the western end of the beach to 3-ft. at the centre, and decreased from there to zero at the sand hills. This estimate was reckoned from the following:

(1) The difference in the beach lines between the surveys of 1841 and 1922.
(2) Direct measurement from foundations now covered by sand.
(3) The inward step between the second and third walls.
(4) Local knowledge of the former position of the beach line.

Here, as at other places of severe erosion, part of the blame must be assigned to the removal by cartage of a considerable portion of the beach material. A further cause is the removal eastward along the bay shore line of beach material under the action of wind, waves and current. There is no appreciable compensation from the littoral drift from the west; for this is largely dissipated by the great break in the continuity of the coast line caused by the bay. The gain from beyond low water, consisting of stones with lengthy sea-weed attachments, is but slight.

As the sand is very fine and light, it is easily moved by the wind when dry. The building of the sea walls has cut off the continuous seepage through from the background of the beach, so that the sand fronting them dries much more quickly than that along the storm beach and sandhills, which is kept in a continuously moist state by the retained water from high tide.

Under the influence of the western winds, wind sand ripples have been observed forming at right angles to the tide line. The grains moving up a long, flat, windward slope, and falling over a sharp lee slope. Under a high constant wind the particles become wind borne and the author has seen sandwaves up to twenty feet long so formed. All the sand so carried is not lost to the critical western end as much is returned by the planing action of the sea.

The form of the curved line of the beach is such that the waves retarded by the shallow water strike, as a rule, at right angles, the waves being parallel to the shore line. Under special conditions, the westerly waves strike slightly obliquely, this also causes a drift of material eastward which is not compensated by the drift caused by the rarer easterly waves.

Owing to the shallowness of the bay, with the consequent drag on the forward motion of the wave form, turbulence is easily caused and the wave often begins to break along the entrance to the bay. When this occurs, there is a greyish turbidity in the water, due to suspended sand particles, which are thus carried by the drift.

In calmer conditions the general current system in the bay has been found to approximate to that shown on the sketch. The tidal current entering from the west streams around the bay at about two miles per hour. The stream, on a rising tide, is pulled eastward by the great volume of water entering the inner bay through the inlet at Rinnashark. Bifurcation is caused by the Pollock Rocks, the landward stream continues through the entrance, the other turns seaward. On a falling tide, much the same conditions hold. The volume of water from Rinnashark, flowing south, tends to continue this motion in the manner of a belt on a pulley. The width, location or velocity of currents is not very constant, due to varying factors. Outside the current streams, the drift follows the same directional course at about a third of a mile per hour.

The movement of beach material caused by the drifts is indicated by the apparent groyning action of the lower portion of the outfall pipe from the town septic tank, which is a foot above sand level. The sand to the west of the pipe is over six inches higher than that to the east; the sandflow around the exit of the pipe has raised the old strand level there by a foot and has entered the pipe and cut down its efficiency by 50 per cent.

A further reason, and the principal cause of the retreat of the shore line, is the driving inwards of the shingle bank caused by the heavy waves of onshore gales occurring on high spring tides. These peel the shingle off in layers and deposit it on the landward side, thus creating an inward creep. That this motion is still progressing is shown by the active gullies and talus fans along the bank.

Notes on the History of the Sea Defences

The Doneraile Estate built the first seawall about 1820. This wall is good and looks as if it will give many years of service. It was erected at the western end of the beach along the lower reaches of the sloping ground. In 1884 it was taken over by the Grand Jury, who spent £400 in putting it in order. Since then small sums have been expended annually on it. The wall is vertical and built of rough stone; the short pitched toe has sunk gradually with the lowering of the foreshore. The wall is being outflanked due to the erosion of the cliff of drift at the western end. The erosion here is unusual, since the wear takes place from below, as the action of the subaerial agencies is slight. A slip of the cliff face might have been expected from the fact that the ground surface is tilled, allowing the drainage water to filter through. The erosion here is at an average rate of nearly one foot per year.

In 1867 the Grand July piled portion of the beach front to the east of this seawall at a cost of £300. These piles consisted of round timber posts in rows parallel to the line of the beach and tied together at the top with hoop iron. In 1871 a further sum of £400 was expended on the works, and in 1877 repairs cost £120. In 1879, the piling was abandoned as the cost of repairs was too great.

In 1881, an experiment was made with groins in the same area. These were of similar construction and ran seaward from high-water mark for about 40 yds. The engineer's report was that they were satisfactory in collecting shingle and checking the advance of the sea. *Hippophae rhamnoides* (Sea Buckthorn) were planted in 1910 on top of the shingle bank by W. E. Duffin, M.I.C.E.I. Co. Surveyor, but these plants were interfered with, being pulled up, and the experiment ruined. Due to lack of funds, the suggested extension of the groynes were not carried out.

In 1896 the Grand Jury built a seawall extending across the sea-frontage of the bog marsh at a cost of £5.000. In 1897, during a heavy gale on an abnormal high tide, this wall was badly damaged and was repaired at a cost of £300. By 1912 much

*Paper read at the Ordinary General Meeting of the Institution of Civil Engineers of Ireland on December 2nd, 1946, and reproduced by permission.

Sea Encroachm nt at Tramore—continued

further damage had been done to the wall, and it was then badly outflanked on the eastern end. In 1913 the present wall and main promenade was commenced, and it was completed in 1915. Heavy scour takes place at the foot of this wall in strong onshore seas, which remove seaward the protecting sand blanket to a depth of four feet and uncovers the masonry apron.

In 1930 the need for the extension of the defence works was supplied by the erection of the third sea wall. This wall, having been stepped inland, still has the advantage of a high shingle and sand bank, which protects the face. This wall, too, is being outflanked steadily by the sea, which continues to work its way around the eastern end where the shingle bank commences.

New Defences—1. Beach

Here an effort is at present being made by the County Council to build up a covering sand bank along the top of the spit by the erection of sand fences. These consist of palisades cresting the shingle bank. The stakes, closely spaced, are about six feet long and are buried to a depth of three feet; the spaces between the posts were interlaced with brushwood, but much of this has been removed by fuel gatherers and the efficiency of the sand trap has thus been greatly impaired. *Psamma arenaria* (Marram Grass) and *Elymas arenaria* (Lime Grass) were planted experimentally by the author along the fences, with successful results.

These fences have a further more important effect, for the posts being embedded in the deeper layers of the shingle are firm and steady, and so stabilise the shingle by preventing the peeling inwards of the upper layer. As this more important function of the sand fence could be adequately fulfilled by a deep rooted hedge along the shingle, a suitable shrub was sought by the author. There is a rich flora growing along the " isthmus," but no wide spreading fixation plant. An attempt was made to grow a privet, which is indigenous to the sandhills, along the fences, but as this plant is neither strong or sturdy it is suitable only as an addition to the fence.

It was learned that at Shoreham, Sussex, a plantation of Tamarisk and on the Chesil Bank and on Blakney Point, Norfolk, a plantation of *Suaeda Fruticosa* fulfilled the required conditions. These were investigated and found to suit admirably the conditions at Tramore. *Tamarisk Gallica* was tried experimentally, with successful results. Tamarisk appears to be in poor demand and, therefore, young shrubs are expensive. Only a few were planted. The tough, wiry growth tapers to a slender top. The stems and side shoots are clothed with minute green leaves in early summer. The shrub, then, looks like a small, graceful conifer. From late summer until the end of autumn the whole growth is covered in a mass of tiny, rosy flowers. This gives the plant a vivid and unusual appearance in its surroundings on the cush and attracts the unwelcome attention of holiday makers, who have removed many of the plants.

To obtain the necessary thick hedge, it would be advisable to provide a light support of posts and wires, to which its main stems could be laced. Cuttings of ripened wood, about 6 inches long, buried half the depth in sandy soil, in the autumn, produces good stock.

Unfortunately, during the war period, *Suaeda Fruticosa* was unobtainable, as no Irish station could be found and the English coast was closed.

Suaeda Fruticosa (Shrubby Sea Blite) is a woody shrub reaching a height of from 3-ft. to 4-ft., it is of bushy habit, recalling a juniper or low yew tree. The numerous branches bear a dense foliage of lineal succulent leaves, often tinged with crimson or purple. It is practically evergreen, leaves being held throughout the winter till the next year's buds begin to expand. Inconspicuous greenish flowers occur in the leaf axils in August. The little fruits, each containing one glossy black seed, should be ripened by the end of November.

This plant, which appears to be the solution to many of the problems of the salt marsh, merits a general description.

Distribution.—The centre of distribution is the Mediterranean area. It is found on the Brittany Coast, in Wales, on the south coast of England, and along the east coast as far north as the Wash. An effort was made to establish it along the Co. Wexford coast, and it was experimented with on the Co. Down coast.

Mode of Establishment.—The simplest way of raising a crop is from seed, but it may also be done by cuttings. Bumper harvests occur every four years; in some years, having dull wet autumns, hardly a seed matures. The seedlings, in a season when they are numerous, grow as thickly as twenty or thirty to the square foot. In the absence of shingling, the seedlings are about 6 inches in the first summer, 9 inches to 1 foot in the second and already sturdy and well branched. After five or six years they reach their full development as much branched bushes, five or six feet high.

Shingle Stabiliser.—The plant develops extensive tap roots, going down three feet into the ground. In the event of shingling, the plants are prostrated down slope. These prostrate branches rejuvenate by developing separate plant by the elongation of the lateral buds in the second year. The result is that the upper layers of the shingle are occupied by a plexus of horizontal branches functioning as rhizomes. The value of the plant depends on this unlimited capacity of vegetative rejuvenation. This besome-like growth naturally holds the shingle, and so a stable beach results. The plant is a halophyte, i.e., it grows on zones covered by Spring tides.

It should not only bind and fix the bank, but should also be decorative and pleasing to the eye.

2. Sandhills

The shingle bank gives place to the sandhills. " Like many, perhaps, most of the sandhills along the Irish Seaboard, Tramore Rabbit Burrow was in prehistoric times the occasional abode of early man, probably of the first race to enter the land. Finds of early fireplaces, hearth stones, hammer stones and red deer antlers testify to this early occupation. The red deer remains would appear to indicate a period somewhere between the palaeolithic and the neolithic ". (Very Rev. Canon Power, D. Litt.) Though old, the sandhills are still in the process of formation, due to the accumulation there of the sand blown from the beach by warm, dry, prevalent south-west winds. Moreover, local variation takes place due to the destruction of much of the protective vegetative covering (1) by rabbits, which even after five years of intensive trapping and ferreting still infest the burrows; (2) by cattle, which are turned out for free feeding on these unfenced areas—cattle are surprisingly fond of the marram shoot; (3) by the spreading of fires, started by picnic parties.

In experimenting with marram cultivation, it was found that planting of tufts was more successful than raising from seed. Growth was assisted by mulching with seaweed cast up on the beach. The field is thickened and strengthened by mowing in mid-winter and letting the tops lie.

In the low stable areas between the dunes, secondary vegetation consisting of mosses, lichens and shrubs has set in, indicating that these areas are ripe for tree planting. For such planting, *Laricio* (Corcian Pine), *Pinus Austrica* (Austrian Pine) and *Pinus Maritima* (Maritime Pine) are suggested.

3. The Salt Marsh

Mr. Malcolmson and Mr. Power undertook the building of three seabanks, which enclosed over 500 acres. These were carried out by Dutch engineers, and were completed in 1857. The final break, inundating the Race Course and Golf Links, took place during the winter of 1912. Since then the tidal waters have come and gone, enlarging the breach, destroying the banks and softening the ground into a bare mud area, across which it is impossible to walk dry shod, as the mud is soft to a depth of from 6 inches to 2 feet.

In June, 1944, the author obtained a number of clumps of *Spartina townsendii* (Rice Grass) and planted these on representative sections on the inner bay. Each of these clumps flourished, flowered, bore seed and propagated vegetatively, thus proving the suitability of this plant to local conditions.

Spartina townsendii (Rice Grass) is a robust, tall growing, rather rigid grass with a continuous system of intercellular spaces

Sea Encroachment at Tramore—continued

raising its haulms two and a half feet above mud level. It is supplied by roots of two kinds: (1) short branching roots for nutrition; (2) deep anchoring roots, penetrating the mud to great depth. (Plants on the experimental site have roots over three feet deep.) Flowering in July-August, it bears, as a rule, a plentiful supply of good seed. The seed ripening period is very long, lasting from October to December, and, as the grain when ripe remains for but a short time on the spike, seed gathering is difficult, and if the seed is allowed to dry the germ is killed, so that cultivated propagation by seed requires skill. The seed, when naturally detached, is carried and deposited on drift lines along the salt marsh. It has a great range of habitat, its distribution extending from high-water mark to six feet below this; it is, however, perhaps more strictly governed by the time of immersion, roughly six hours immersion being its limit per tide.

This plant, which has become of such vital importance to the reclamation engineer, has but a short history, as it was noted for the first time in 1870 on the Southampton salt-marshes. It was recognised by the brothers, Henry and James Groves, as a new and distinct species in 1880, and was then named by them.

Lord Montagu of Beaulieu, by his evidence before the Royal Commission on Coast Erosion, drew public attention to it. Dr. Otto Stapf, Keeper of the Royal Botanic Gardens, Kew, conducted the first scientific inquiry, and admirable work was done by F. W. Oliver, D.Sc., LL.D., F.R.S., Emeritus Quain, Professor of Botany, University College, London, and worthily continued by James Bryce, B.Sc., East Anglian Institute of Agriculture. This raised its status from an unknown grass to one of the prime weapons of the reclamation engineer.

It has been established in Ireland, on the Estuaries of the Shannon, of the Lee and of the Suir, at the head of Clew Bay, on Belfast Lough and at the North Bull in Dublin Bay. Mr. J. Healy, Mr. A. D. Delap, The Marquess of Sligo and Mr. J. H. de Bromhead have been associated with its establishment in these various areas. These plantations are mainly successful.

The reclamation properties of Rice Grass are manifold:

(1) It quickly colonises soft, barren mud.
(2) The erect stems. by retarding the flow of tidal currents, causes material in suspension to fall to the surface, which is thus raised.
(3) The growth of the roots and underground stems binds, consolidates and expands the superficial layers.
(4) The plant has the ability of maintaining its position as the ground rises.
(5) Due to the plentiful intercellular roots, the ground level as a whole is raised by meadow establishment.
(6) It produced a heavy humus, resulting from the decay of the previous season's shoots.

The Dutch, traditionally interested in land reclamation, early adopted this plant, which profoundly modified their current practice in poldering. In the Kreekrak Polder, the measured rise between 1926 and 1932 with Spartina was between four and five feet as against a rise of under one foot for the previous six years warping without Spartina.

Spartina is a suitable feed for live stock, though it is held that the milk of milch cows is tainted by it. Cattle, horses, sheep, pigs and rabbits are all fond of it. They will leave more luscious grass on the higher ground to graze upon it as the tide runs out. Spartina would be a very convenient reserve crop, as it remains upon its roots throughout the winter. (To obtain rapid meadowing for reclamation purposes the field, therefore, has to be protected.)

Paper has been made from it, and it is possible that many other uses have been discovered during the war.

If this Tramore area were successfully meadowed, the unhealthy and unsightly slob land would be eliminated and replaced by firm productive land over which passage would be possible. " The change in scenic effect is profound; to what had been a boundless mire, there has succeeded a covering of tender green taking wonderful tints from sun and sky." (Professor F. W. Oliver.)

As a result of his study, the author concluded that the needed defences against the sea encroachment—taking into account the limited finances available—must necessarily depend on the cultivation of suitable plants which would bind and hold the sands, shingles or muds of the area.

The author desires to acknowledge gratefully the generous assistance given to him in particular by Professor F. W. Oliver, D.Sc., LL.D., F.R.S., Burg el-Arab, Egypt; James Bryce, Esq., B.Sc., East Anglian Institute of Agriculture, Chelmsford; Rev. Canon Power, D.Litt., John's Hill, Waterford; B. Gerritzen, Esq., Agricultural Attaché to the Netherland Embassy, London.

Tugs for South African Harbours

The " Railway Bulletin," the journal of the South African Railways and Harbours, announces that three new tugs are to be purchased to enable the harbours to cope with the growing volume of shipping using South African ports. It is estimated tnat these tugs, two of which will be oil-burning and one coal-burning, will cost more than £500,000. A contract for £184,000 has already been placed for the coal-burning tug; trials will take place within sixteen months of approval of the final drawings and she will be ready to sail for East London within three weeks of the completion of satisfactory trials.

Tnese new vessels will prove a welcome addition to the Administration's fleet, since the present position is extremely difficult, particularly in regard to the larger class of tug. Additional tugs would, under normal conditions, have become necessary during the war, but as in other spheres of transport operation, shortage of supply proved a serious handicap.

The position was further aggravated by the sinking of the tug *W. H. Fuller* at East London in 1944, and the damage suffered by the Durban tug *E. S. Steytler* in January of this year, when she was badly holed by the propeller of the m.v. *Georgic*. Now, with the return to the South African service of many large mail ships, the harbour authorities are finding it difficult to cope with the movement of heavy ships.

Tugs in South African waters are, at times, called upon to undertake long-distance towing operations, and consideration was given to this aspect when specifications for the new tugs were prepared. All the harbour tugs at present in use are coal-burning, since this type is eminently suited for normal harbour working, while the use of South African coal makes them economical to run. For long-distance ocean-going jobs, however, oil fuel is essential, while there are certain other radical differences in the form of the hull and superstructure. In the circumstances, a special committee was appointed to design a tug that could be used on normal harbour working, but could, in cases of emergency, carry out ocean-going towing work.

The specifications for the two oil-burning tugs which are to be ordered have been drawn up to meet these demands. The tugs will have an operating range of 2,000 miles with the machinery developing 1,700 h.p., although their indicated horse-power for shorter ranges will be 3,000. They will be stationed at Cape Town and Durban, respectively, where they will be on hand to deal with emergency calls in either the Indian or Atlantic Ocean.

The oil-burning tugs will have a total length of 165-ft., a breadth of 33-ft. 6-in., and a moulded depth of 17-ft. 6-in., whereas the coal-burning tugs on order will be only 151-ft. long and will be 6-in. narrower. The depth will be only 17-ft., while the horse-power will be approximately 2,500.

The Port of Rotterdam.

Owing to a clerical error in the translation of Ir F. Posthuma's article in our last issue, it is necessary to state that his intended opinion was that the driving of the steel sheet piling into the deposited sand foundation at the Merwehaven " affects the stability of the whole structure favourably " (page 36). Also, Ir Posthuma points out that in the penultimate paragraph, on page 38, "one-third " should be read in place of " two-thirds " of the port's present capacity, as having been used during 1946.